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Technical Report 582

MILITARY SYMBOLOGY:
A USER-COMMUNITY SURVEY

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Perceptronics, Incorporated

BATTLEFIELD INFORMATION SYSTEMS TECHNICAL AREA

U. S. Army
Research Institute for the Behavioral and Social Sciences

September 1981

U. S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the

Deputy Chief of Staff for Personnel

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Research accomplished under contract to
the Department of the Army

Perceptronics, Incorporated

NOTICES

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: Technical Report 582	2. GOVT ACCESSION NO.: AD-A138921
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Military Symbology: A User-Community Survey	5. TYPE OF REPORT & PERIOD COVERED: Technical Report
6. PERFORMING ORG. REPORT NUMBER: PFTR-1063-81-9 ✓	
7. AUTHOR(s): Betty M. Landee, Ralph E. Geiselman, Cynthia S. Clark	8. CONTRACT OR GRANT NUMBER(s): DAHC19-78-C-0018
9. PERFORMING ORGANIZATION NAME AND ADDRESS: PERCEPTRONICS, INCORPORATED, 6271 Variel Avenue, Woodland Hills, CA 91367	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 2Q163739A793
11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Army Research Institute, 5001 Eisenhower Avenue, Alexandria, VA 22333	12. REPORT DATE: September 1981
	13. NUMBER OF PAGES: 139
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Technically monitored by Franklin L. Moses and Beverly G. Knapp

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Symbols
Military Symbology
Graphic Portrayal
Information Requirements
User Requirements
Tactical Information
Cluster Analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

See #20 (on back)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

#20 - ABSTRACT

The primary goal of this research concerned the identification of important military concepts that are not portrayed by the Army symbology standard (FM 21-30). A secondary goal was to examine the use of non-standard portrayal methods by military users. Semantic cluster analyses performed on the survey data obtained revealed five major concepts; six additional concepts were identified on the basis of their high incidence of personalized portrayal.

Research findings indicate the need for an updating of FM 21-30, both for portraying additional information about weapons, equipment, etc. as well as for addressing those concepts identified in the report which represent dynamic aspects of the battlefield.

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Office, Deputy Chief of Staff for Personnel
Department of the Army

September 1981

Army Project Number
2Q163739A793

Human Factors in Training and
Operational Effectiveness

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FOREWORD

The Human Factors Technical Area of the Army Research Institute is concerned with the human resource demands of increasingly complex battlefield displays used to acquire, transmit, process, disseminate, and utilize information. Current research focuses on human performance problems related to the soldier system interface and is concerned with such areas as software development, the presentation of information on complex displays, user-oriented systems, decision-making, systems integration and utilization.

Of special interest are human factors problems related to developing and validating new ADP compatible symbology concepts for efficient display of tactically significant information. The current study is the result of task two of a three-task symbology contract effort by Perceptronics, Inc. Using a sophisticated survey instrument and cluster analysis technique, users of military symbology identified important tactical concepts not currently portrayed by the Army Symbology Standard, FM 21-30.

We are grateful for the cooperation and assistance given to this project by the U.S. Army War College (Carlisle Barracks, PA), Aviation Center and School (Fort Rucker, AL), Combined Arms Combat Development Activity and Command and General Staff College (Fort Leavenworth, KS), Infantry Center and School (Fort Benning, GA), and the Intelligence Center and School (Fort Huachuca, AZ).

This research is responsive to general requirements of Army projects 2Q163739A793, and to special requirements of the U.S. Army Combined Arms Combat Development Activity (CACDA), as well as HRN 80-307 (Display of Battlefield Information).

JOSEPH ZEIDNER
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MILITARY SYMBOLOGY: A USER-COMMUNITY SURVEY

EXECUTIVE SUMMARY

Requirement:

The primary purpose of the work described in this report is the identification of military concepts that currently do not have a standard method (FM 21-30) of graphic portrayal. A secondary purpose is to examine non-standard methods for portraying these concepts.

Procedure:

Military officers were asked to generate their requirements for information on a situation display as they worked through a tactical scenario. They were then asked to assess how well the information requirements identified could be portrayed by the Army standard symbology, FM 21-30. The information requirements were obtained from survey sessions in the form of questions and answers; these data were then organized and summarized by the application of a semantic cluster analysis. Instances of non-standard (personalized) methods of portraying the required information were also recorded.

Findings:

A total of 839 tactical questions were generated during 14 elicitation sessions. Survey participants classified 29% of the information to be obvious from a display with conventional symbology, 28% to be obtainable by inference, and 43% of the information to be unavailable from a display. Further, 30% of the information requirements obtained had been displayed with non-standard (personalized) portrayal methods. Four cluster analyses of the tactical questions were conducted and five major military concepts were identified which are not contained in FM 21-30, but are being graphically portrayed by various users. The major concepts identified from the cluster analyses include status, capability, availability, threat, and logistics. Additional concepts were identified on the basis of their high incidence of personalized portrayal.

Utilization of Findings:

Research findings indicate a need for an update of FM 21-30, both for portraying new concepts, such as equipment and weapons, as well as addressing those concepts identified as dynamic aspects of the battlefield.

MILITARY SYMBOLOGY: A USER-COMMUNITY SURVEY

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INTRODUCTION

Background

Military symbols as specified in Army Standard FM 21-30, NATO D-49 (1980) provide a graphic shorthand for unit identification and location on battlefield situation displays. With the advent of modern weaponry and the automated command and control technology being developed, these current symbols are no longer adequate to meet user needs. It is now recognized that other types of battlefield information need to be symbolized, such as unit status, threat, mobility, availibility etc.

The Army Research Institute initiated a three-year research and development program to assess symbology for today's and tomorrow's user needs. The first year effort focused on establishing a framework for the development of improved military symbology (Ciccone, Samet and Channon, 1979), and on the demonstration of a task-based approach for determining map information requirements (Landee, Samet and Foley, 1979). The second year of work was concerned with extending the symbology development framework by systematically enlarging and refining the related information requirements data base (Landee, Samet and Gellman, 1980), and by establishing and demonstrating an evaluation model and methodology for empirically testing new approaches to improving the symbolic representation of battlefield information (Samet, Geiselman and Landee, 1980). The third year of the research effort focused on three distinct tasks, namely: (1) the creation of an automated tactical symbology catalog containing a collection of existing symbologies from numerous sources (e.g., NATO, FM 21-30, etc.); (2) the survey of the user community to identify relevant tactical concepts that do not have a standard graphic portrayal method; (3) the development of a human-factor criterion to resolve redundancies and conflicts between existing and proposed symbols.

This document reports the findings of the survey portion of the third year research effort. For Task 1, a hard copy version of the automated symbol catalog, may be found in a separate volume (Tactical Symbology Catalog). The findings of Task 3 of the research, development of human-factor criterion, may be found in a separate volume (Perceptual Discriminability as a Basis for Selecting Military Symbols). An overview of the entire third year research may be found in a separate volume (Graphic Portrayal of Battlefield Information--Executive Summary).

Statement of the Problem

The conventional symbology (FM 21-30) is used for identifying unit types and sizes, as well as designations, principal weapon systems, and locations. One user has described conventional military symbology as

having been "designed for an era of more time and less information." [1] FM 21-30 has not been updated since 1970, thus numerous newer weapons, equipment, and units do not have standard symbols. In the absence of formal standards, informal standards evolve among those groups of users dealing with the new information (Landee, Samet and Gellman, 1980). A proliferation of personalized symbols users has evolved in an attempt to represent such concepts as availability and status.

The loss of standards however, through personalization, is likely to reduce the communication value of the display and may result in misunderstandings, confusion, errors or time delays. Numerous systems are scheduled for fielding within the next few years, and many of these systems will have graphic capabilities. With limited standards to follow, displays may evolve independently, possibly on system-by-system basis, producing little agreement across systems about how to portray a given concept.

Objectives

The work described in the current report concerns the identification of important military concepts which currently do not have a standard method of graphic portrayal. To accomplish this goal, tactical information requirements were obtained from a survey of the user community. In addition, the information requirements obtained were related to how well current symbology is suited to meet these requirements, allowing an assessment of the adequacy of conventional symbology to meet modern needs.

Technical Approach

An elicitation prodedure was developed wherein users were asked to generate task requirements in a tactical scenario. While symbology was a prime concern of this research effort, no attempt was made to confine survey participants to information requirements which, in their opinion, could or could not, or should or should not be portrayed on graphic displays. Rather, a data base of information requirements was formed which was independent of state-of-the-art graphic capabilities.

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[1] "A Command Post is not a Place," Concept Paper by General Paul Gorman.

METHODOLOGY

Group Composition

Elicitation sessions were conducted with a number of different user groups. Table 1 provides a breakdown of the groups surveyed. Survey participants included students, such as officers at the Army War College, as well as instructors, such as faculty at the Infantry Center and School. Generally, three officers participated in each elicitation session, but scheduling difficulties required that a few sessions included two or four participants.

All participants in the survey were required to have had field unit experience as well as familiarity with current doctrine. Table 2 contains a list of the background experience of the officers surveyed (39 survey participants held the rank of Major or above). Many participants had background experience in more than one area, such as both intelligence and operations. These individuals, though assigned a specific role, were permitted to draw upon their diverse background experience rather than be restricted to the information needs of their specified role. Because of limitations in participant availability, a maximum time constraint of three hours was imposed on the length of a session.

Table 1
USER COMMUNITY SITES SURVEYED

U.S. Army User Group	# of Sessions	# of Officers
Army War College Carlisle Barracks Pennsylvania	3	9
Aviation Center and School FT. Rucker Alabama	2	6
Combined Arms Combat Development Activity-- FT. Leavenworth Kansas	2	7
Command and General Staff College-- FT. Leavenworth Kansas	3	8
Infantry Center and School FT. Benning Georgia	2	6
Intelligence Center and School FT. Huachuca, Arizona	2	6

TABLE 2

BACKGROUND EXPERIENCE
OF SURVEY PARTICIPANTS

COMMAND:	Commanders at Brigade and Battalion level, including Aviation.
PERSONNEL:	G-1, G-1 Section.
INTELLIGENCE:	G-2, S-2, G-2 Section, Collection Manager.
OPERATIONS:	G-2, S-3, G-3 Section, G-3 Air.
LOGISTICS:	G-4, G-4 Section, G-4 Air.
FIRE SUPPORT:	Fire Support Element, Fire Support Coordinator.
AIR DEFENSE:	ADA Officer.
ENGINEER:	Combat Engineer.
CHEMICAL, BIOLOGICAL, RADIOLOGICAL:	Chemical Officer.

ELICITATION PROCEDURE

The elicitation procedure followed a question-and-answer model. Participants were instructed to generate tactical questions, which, if answered adequately, would permit them to comply with the doctrinal requirements of standard military practice. Table 3 provides a list of the sequence of events in the elicitation session. The background research materials and instructions to the survey participants are contained in a previous report (Landee, Samet, and Gellman, 1980).

To help guide the elicitation process, participants worked within a specifically defined tactical scenario. While only one scenario was employed in a given session, four scenarios were utilized in the survey:

(1) Offensive Operations -- European Setting.

(2) Defensive Operations -- European Setting.

(3) Offensive Operations -- Middle Eastern Setting.

(4) Defensive Operations -- Middle Eastern Setting.

The scenarios employed (see Appendix A) were fictitious and had been adapted from courses taught at the Command and General Staff College.

TABLE 3

ELICITATION PROCEDURE:
SEQUENCE OF SESSION EVENTS

1. Presentation of research effort background.

2. Presentation of tactical scenario.

3. Instructions given for question-generation procedure.

4. Presentation of a set of excerpts from doctrinal fundamentals.

5. Individual question generation.

6. Group discussion of questions.

7. Question Data Form completed by each participant for their own questions.

8. Steps 4, 5, 6, and 7 repeated until all sets of doctrinal fundamentals had been presented.

9. Participants are debriefed.

Each scenario contained the following elements: (1) an account of events leading to hostilities, (2) mission statement, (3) comparison of forces, (4) task organization, and (5) sketch maps of the region.

The tactical fundamentals of offense and defense, such as "See the Battlefield" and "Understand the Enemy," were presented to focus participants' attention on the critical dimensions of the battlefield. For example, in response to "Understand the Enemy," one might ask: "what is the principal deficiency of a specific enemy unit (e.g., personnel, ammunition, mobility,...)?" The fundamentals of defense and offense were taken from FM 71-100 (Armored and Mechanized Division Operations, September 1980). Table 4 contains a list of the doctrinal fundamentals of offense and defense.

Participants were asked to write their information requirements in the form of questions. These questions were written on separate index cards along with a plausible answer to the question. Following the question-generation phase, which was accomplished on an individual basis, each participant read their questions to the group in an effort to identify and eliminate redundant questions on the basis of group consensus. Once all the questions had been read, and redundant questions eliminated, participants were given a Question Data Form (QDF; see Figure 1) to complete. A participant completed one form for each of their own questions, and the question-card was attached to its respective QDF. The process of individual question generation and group review was repeated until all of the sets of fundamentals of offense or defense had been read. With the completion of the final iteration, participants were thanked for their cooperation and excused.

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TABLE 4

DOCTRINAL FUNDAMENTALS

FUNDAMENTALS OF OFFENSE:

Set 1:

(1) See the Battlefield
(2) Concentrate Overwhelming Power

Set 2:

(3) Suppress Enemy Defensive Fires
(4) Shock, Overwhelm, and Destroy the Enemy

Set 3:

(5) Attack the Enemy Rear
(6) Provide Continuous Mobile Support

FUNDAMENTALS OF DEFENSE:

Set 1:

(1) Understand the Enemy
(2) See the Battlefield

Set 2:

Concentrate at the Critical Times and Places

Set 3:

(4) Fight as a Combined Arms Team
(5) Exploit the Advantages of the Defender

QUESTION DATA FORM

EVALUATOR ROLE: _____ QUESTION NO.: _____

1. From looking at a display with conventional (FM 21-30) symbology, the answer to this question is:

   ☐ Obvious ☐ Obtainable by inference ☐ Unavailable

2. Have you ever used your own (i.e., personalized) method (e.g., special symbol, annotation, overlay, etc.) to represent the type of information addressed by this question?

   ☐ Yes ☐ No

3. If you answered yes to question 2, did you use a personalized method which

   ☐ Modified an existing (FM 21-30) symbol ☐ Created a new symbol

4. Which of the following techniques best describes the way in which you used a personalized method to represent the information addressed by this question?

   ☐ Color coding ☐ Alphanumeric notation

   ☐ Shape alteration of symbol ☐ Other (please specify)

COMMENTS:

Figure 1. Sample Question Data Form

ANALYSIS OF RESULTS

SEMANTIC CLUSTER ANALYSIS--INFORMATION REQUIREMENTS

The output of the elicitation procedure combined over all sessions consisted of information requirements expressed as 839 tactical questions. The data were organized into a comprehensible scheme using a semantic clustering technique. This technique provides a method for exploring and uncovering potential structure and interrelationships inherent in the tactical questions.

The semantic clustering technique has been detailed elsewhere,[2] and will be discussed here only briefly. Table 5 contains an overview of the technique. The first step requires the development of a set of features on which questions may be described. The 64 features that were selected were derived from a careful examination of the question content as well as relevant military literature. Appendix B contains the feature names as well as definitions, synonyms, or related terms for each feature. The second step in the technique required the identification of relevant features contained in the tactical questions. Feature identification resulted in an expression of each tactical question as vector of 1s and 0s.

In order to identify common concepts within the tactical questions, an index of similarity[3] was calculated between questions on the basis of semantic similarity. The logical basis for the procedure is that the

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[2]Landee, Samet, and Gellman, 1980.

[3]The index of similarity among a pair of questions was calculated using the following formula (from Stefflre, 1972):

$$S_{ij} = \frac{R_i R_j' + R_j R_i}{R_i R_i' + R_j R_j'}$$

ANALYSIS OF RESULTS

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TABLE 5

OVERVIEW OF SEMANTIC
CLUSTERING TECHNIQUE

(1) Develop a set of semantic features to describe questions.

(2) Express each question as a vector of 1s and 0s based on the relevance of the features to the tactical question. If any of the following criteria were met, a 1 was assigned for the question for that feature.

(b) The feature is explicit in the question, e.g., "What is the current friendly available supply requirement?" The features "friendly," "supply," and "availability" are all explicit in the question.

(b) The feature is implicit in the question, e.g., "What size and type of units are we facing?" The feature "enemy," though not explicit in the question, is implicitly represented.

(c) The feature is explicit in the sample answer(s) provided, e.g., Question--"The 23d Division is opposed by 9 divisions, at what strength are those divisions?" Answer--"The 3 MRD are at 100% strength, the 6 tank divisions are at 85% strength. The categories of unit size and type are explicit in the answer. This criterion is necessary because in many cases the answer serves to clarify the information requirements of the question.

(3) Using a matrix of questions by features, create a similarity matrix of questions by questions.

(4) Perform a cluster analysis of the similarity data.

more common the presence of specific semantic features in two tactical questions, the greater the similarity between the two questions. This step requires the generation of a question by question similarity matrix. The quantity of tactical questions collected precluded the generation of an overall similiarity matrix (839 x 839). Thus, the results of the previous semantic cluster analysis (Landee, Samet, and Gellman, 1980) were used to guide the selection of meaningful subsets of questions for separate analyses.

Earlier work identified enemy and friendly information as the two largest clusters of information. Therefore, questions were divided in the following manner to form four separate analyses: (a) questions concerned exclusively with enemy information (392); (b) questions concerned exclusively with friendly information (329); (c) questions concerned with both enemy and friendly information (68); and (d) questions which were not concerned with either enemy or friendly information (50).

The cluster analyses were performed by a computer routine entitled "Aggregation Hierarchical Clustering Program" (Oliver, 1973). In this program, the similarity data are clustered using a technique sometimes referred to as "mean between" clustering (e.g., Andenberg, 1972).[4]

QUESTION DATA FORM--PERSONALIZED PORTRAYAL METHODS

The question data form (QDF) provided an assessment of the adequacy of conventional symbology to meet the needs of the users surveyed; it was

[4]According to this technique, the distance between clusters A and B is the mean of the similarities between points A and B.

obtained for each of the information requirements collected during the survey. User responses to the QDF were compiled and retained on a question-by-question basis.

RESULTS AND DISCUSSION

SUMMARY OF SEMANTIC CLUSTER ANALYSIS RESULTS

The semantic cluster analyses provided a meaningful description of user information requirements as well as an assessment of the ability of conventional symbology to portray the information. From the analysis of friendly information, for example, it is evident that nearly half of the user required information is unavailable from a display with conventional symbology. Further, the major concept contributing to the unavailable classification was status information.

Figure 2 contains the four major information categories which were most salient in the analyses, and displays the adequacy of conventional symbology to portray the information. Location information was prominent in all four analyses (tactical questions = 341), as was status information (tactical questions = 228). Capability information appeared in the enemy and friendly analyses (tactical questions = 78). Availability information was a prominent feature of the friendly analysis and the analysis of information not specific to friendly or enemy units (tactical questions = 55). From Figure 2 we see that location information is the most obvious information contained on a display with conventional symbology, whereas, status, capability, and availability information is largely unavailable from a display with conventional symbology. This result illustrates the limited capacity of FM 21-30 to display user information requirements.

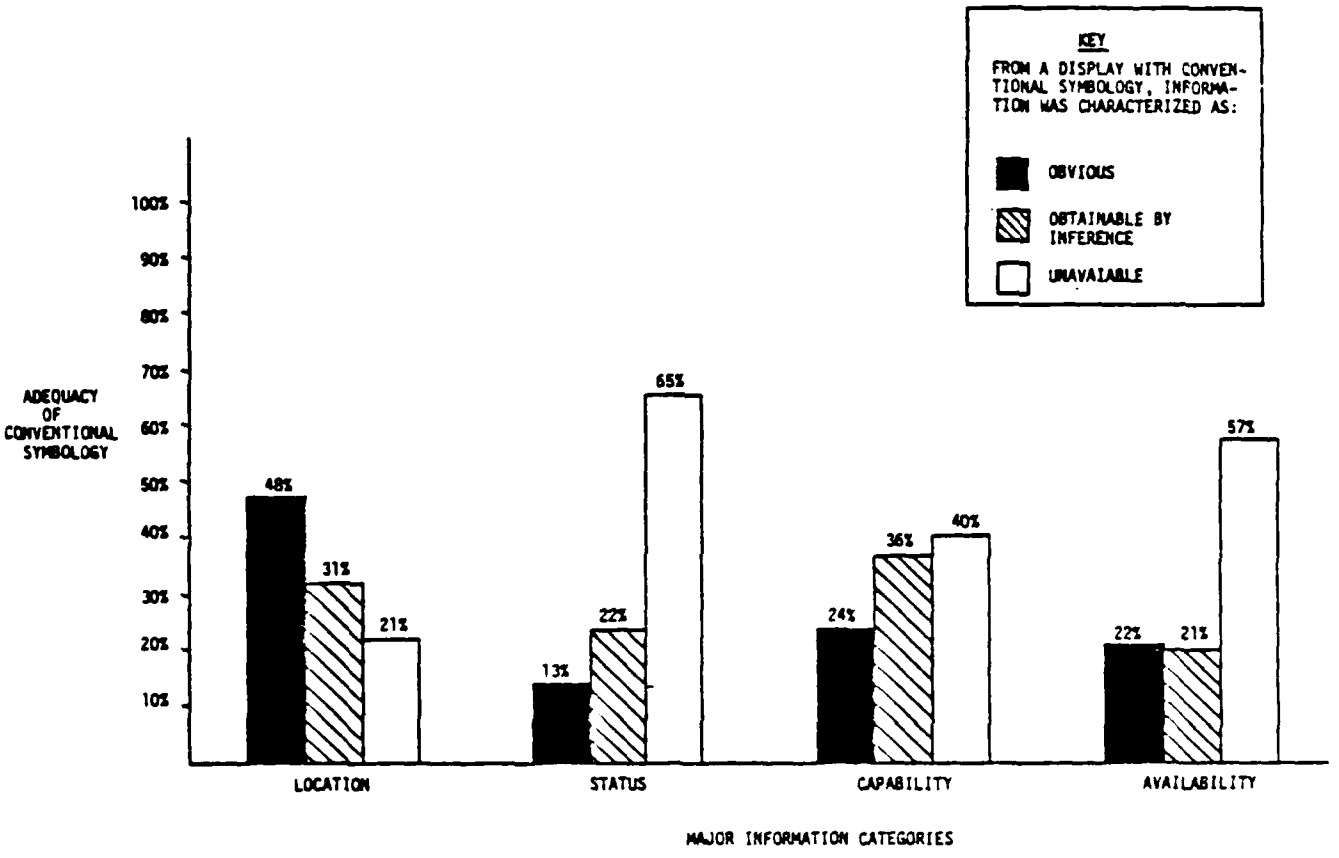


Figure 2. Display Potential of Major Information Categories

From this survey, the following percentages of personalized portrayal of the information were found across analyses: location -- 22%; status -- 33 1/3%; capability -- 20%; and unavailability -- 31%.

CLUSTER ANALYSIS OF INFORMATION

A total of 839 tactical questions were obtained from the elicitation sessions. Size restrictions on the computer program required the data to be divided into smaller groups for analysis. Four separate analyses were conducted as follows: (a) questions pertaining exclusively to enemy information (392); (b) questions pertaining exclusively to friendly information (329); (c) questions pertaining to enemy and friendly information (68); and (d) questions which did not pertain to either enemy or friendly information (50). A separate discussion of each analysis is contained in this section. Appendix D contains tree diagrams from each of the analyses.

With the clustering technique employed here, tactical questions were restricted to membership in a single cluster; in other words, questions were clustered only in terms of the strongest relationships. Although questions appear together in a cluster on the basis of common features, questions in another cluster may also share some of the same features.

The names of clusters and subclusters are derived directly from the information contained in the tactical questions which are associated with a specific cluster or subcluster. Often the name assigned to a cluster reflects the dominant semantic feature or features contained in the cluster. In a few instances the cluster has been assigned a different name; this instance occurred when a cluster was composed of a number of features which were related, for example, all the features related to terrain as opposed to unit information.

Enemy Information

The cluster analysis conducted on the 392 tactical questions pertaining to enemy information produced four major clusters of information. These clusters were assigned the following names, taken directly from the questions, to reflect the common concept contained in each: location, status, capability, and type. The four clusters classified 90% of the tactical questions concerning enemy information. Table 6 provides an overview of the four major clusters in this analysis.

Location. The first major cluster of tactical questions (number of questions N = 176) pertained to enemy location information. More than half of these questions concerned the location of enemy threat, which was observed to decompose further to expected threat and current threat. Specifically, expected threat included such concepts as weapon ranges, while current threat contained concepts such as 2nd echelon activity. Other questions contained in the location cluster dealt with specific unit information, such as electronic warfare and logistical units. In addition, two small subclusters of questions dealing with the location of routes and obstacles formed a weak association with the location cluster.

Status. The second major cluster of tactical questions (N = 67) pertained to status information. In most cases, status questions concerned units and weapons, and frequently the information sought involved percentage strength estimates. Numerous unit status questions were concerned with personnel, in terms of strength and morale. A separate subcluster of unit status information pertained to logistical and weapon information.

TABLE 6

OVERVIEW OF ENEMY CLUSTER ANALYSIS RESULTS

INFORMATION CLUSTER NAME	FREQUENCY OF QUESTIONS	CONTENT OVERVIEW
Location	45%	Primary concern regarded the location of threat; also, the location of specific units.
Status	17%	Current situation regarding weapons, units, communications, and logistics.
Capability	15.6%	Threat related information including sustainability, special weapons, and air threat; logistical information including vulnerabilities and routes.
Type	12.8%	Detailed capability and status information, such as specific weapons and vehicles included in enemy units.

Capability. Enemy capability was the common concept within the third major cluster of tactical questions (N = 61). Most of the questions in this cluster dealt with threat related information, including enemy sustainability and attack capability. Questions concerning special weapons and air threat were predominant throughout the threat subcluster. Many of the capability questions required a yes or no type of answer, as opposed to detailed identification of the nature of the threat. The second subcluster of capability information was concerned with logistics. These questions included logistical vulnerability, routes, and reinforcing capability.

Type. The fourth major cluster of enemy information dealt with the type of unit or its attributes (N = 50). The concept type refers to a greater specificity of information, such as the type of vehicle (e.g., BMP), or type of ammunition (e.g., HE chemical). Two major subclusters of information within this cluster dealt with status and capability. These subclusters differ from the major clusters of status and capability in terms of the level of information detail. For example, within the capability cluster, questions typically dealt with whether or not the enemy possessed a particular capability, such as chemical warfare; whereas the capability questions subsumed under the type cluster might require the identification of the blistering agent or non persisting nerve gas chemical capability. In addition, a small subcluster of questions concerned with reinforcements formed a weak association with the type cluster. The major concepts within this subcluster included unit size and reinforcement time.

Minor Clusters. The remaining tactical questions clustered into three small clusters. One cluster (N = 16) pertained to three different and weakly related concepts, namely, enemy organization, indications, and electronic warfare. The second small cluster (N = 15) contained two

subclusters, movement and activity, which also were weakly related. The third small cluster (N = 7) dealt with attack information. Most questions in this cluster concerned projected time information.

Enemy Information Portrayal Deficiencies. Table 7 provides a summary of the enemy information data obtained from the survey. This table provides the number of questions contained in each cluster as well as the percentage of questions which survey participants characterized as either obvious, obtainable by inference, or unavailable from a display with conventional symbology. The final column in the table lists the percentage of questions in the cluster for which participants noted that they have used a personalized method to portray the answers.

Overall, the results of this survey indicate that enemy information is almost evenly divided between obvious (34%), obtainable (32%), and unavailable (34%) from a display with conventional symbology. The majority of information characterized as obvious is found in the location cluster. This finding is predictable since the questions in this cluster generally deal with the identification of entities, such as units. However, 47% of the questions pertaining to location were characterized as either obtainable or unavailable. The explanation for this finding is that users were identifying entities such as SCUD and FROG units, and enemy 2nd echelon, which are not portrayed in FM 21-30.

The majority of the information characterized as obtainable by inference is found in the location and capability clusters. The obtainable by inference classification indicates that part of the relevant information is portrayed. In many instances, partial information may direct the user to relevant sources in an effort to ascertain their information. For example, identification of an enemy unit designation when cross-referenced with files or reports may enable the identification of nu-

TABLE 7

ENEMY INFORMATION PORTRAYAL DEFICIENCIES

INFORMATION CLUSTER NAME	NUMBER OF QUESTIONS	From a display with conventional symbology, the information is: OBVIOUS	OBTAINABLE	UNAVAILABLE	Percent of requested information portrayed with personalized methods
Location	176	53%	32%	15%	24%
Status	67	12%	22%	66%	24%
Capability	61	27.5%	45%	27.5%	45%
Type	50	16%	32%	52%	22%
Organization/Indications/ Electronic Warfare	16	25%	37.5%	37.5%	19%
Movement/Activity	15	29%	14%	57%	47%
Attack	7	0%	0%	100%	43%
	392	34%	32%	34%	27%

clear capable units. In this example, unit designation is obvious from a display, but it is partial information in terms of identifying nuclear capable units. Most of the information characterized as obtainable cannot be portrayed directly with FM 21-30 symbology and includes chemical and unique weapon capabilities, and counterattack as well as bridging capabilities.

The majority of information characterized as unavailable from a display with conventional symbology is found in the status, type, and location clusters. Status is dynamic information which is not portrayable with conventional symbology; thus, the characterization of status as unavilable is not surprising. The type cluster of information, as noted earlier, deals with very detailed information, which is not portrayable with FM 21-30 symbology. Information contained in the location cluster which was characterized as unavailable frequently contained concepts, such as status, as well as location, thus leading to the unavailable classification.

Friendly Information

The cluster analysis conducted on the 329 tactical questions pertaining to friendly information produced thirteen clusters of information. Table 8 contains an overview of these clusters. The first six of which classified 72% of the tactical questions.

Status. One third of the friendly information was found in two subclusters which had the same major concept in common, namely status. The largest status subcluster (N = 77) dealt with logistic and time/location status information. The relationship between these subclusters were somewhat weak. The logistics subcluster (N = 64) was concerned with quantity information about weapons, equipment, ammunition, and person-

TABLE 8

OVERVIEW OF FRIENDLY CLUSTER ANALYSIS RESULTS

INFORMATION CLUSTER NAME	FREQUENCY OF QUESTIONS	CONTENT OVERVIEW
Status		
Logistics and Time/ Location Information	23%	Logistical information concerned supply and personnel availability, capability, and time and quantity; time/location dealth with reinforcements, control measures and obstacles.
Non Logistical Information	10%	Unit information concerning special weapons, communications; non unit information about routes, positions, and obstacles.
Location		
Unit Related	17%	Unit location information concerning actual and projected locations.
Artillery/Air Defense Weapons	5%	Locations of artillery and air defense weapons.
Terrain Related	3%	Location of routes, obstacles, and key terrain.
Availability/Assets	14%	Availability of units in terms of time and quantity.
Air Attack	6%	Air attack information dealing with unit locations and time.
Capability	5%	Logistical capability in terms of quantity available; weapon capability information.
Plans	4%	Plans concerning defensive use of special weapons, EW; route and obstacles plans.
Movement	4%	Time and distance factors for units and vehicles.
Projected Quantity/Time	3%	Projected amount of casualties, force ratio; projected time of completion of engineer activities.
Logistics	3%	Logistical vulnerabilities and activities.
Activity	2%	Information concerning control measures; priority of fires and terrain use.

nel. Status for this logistical information was typically in percentages or amounts within a time frame. Generally, the logistical information was quite detailed in nature, sometimes requiring the quantity of specific weapons or MOS. The time/location subcluster was concerned with the status of obstacle plans, reserves, weather, and control measures.

The second subcluster of status information contained tactical questions related to both unit and non unit information (N = 34), but unrelated to logistics or time/location. Most of the unit information dealt with special weapons and communications status. The non-unit information pertained to obstacles and positions. The primary difference between the first and second subclusters was the level of information detail of the information. In the first subcluster the information was rather detailed in nature, the level of detail in the second subcluster was not as great. For example, nuclear release status could be answered as either limited or general, prepared positions were either ready or not. Thus, the information in the two subclusters is related, but the level of detail of the information differed considerably.

Location. Three clusters of information were related to location and these clusters together accounted for approximately one quarter of the friendly information. The first location subcluster dealt with unit locations (N = 55). Most of the questions in this cluster concerned the actual or projected locations of logistics units, reserves, or available units. A few questions were related to the locations of particular sizes of units. The second subcluster of location information concerned artillery and air defense weapons locations (N = 16). Range, positions, and Division assets were the types of information contained in this

subcluster. The third location cluster of information was related to terrain (N = 11). The information contained in this cluster dealt with obstacle, and key terrain feature locations.

Availability/Assets. Availability and assets were the primary features of another major cluster of tactical questions (N = 47). Most of the questions in this cluster were related to the availability of units. Specifically, the information required dealt with the quantity of available units and in some cases the time when units would be available.

Air Attack. One small cluster of tactical questions dealt with air attack (N = 18). Attack location and time were the primary concepts contained in the cluster.

Capability. The capability cluster (N = 17) contained two subclusters dealing with logistics and weapons. The logistic subcluster contained a variety of capability questions including concerns about repair, replacement, and transportation. In general, the logistical questions required detailed information such as percentages or quantities of certain items. Within the weapons subcluster, questions concerning smoke and weapons commonly required unit size and quantity information.

Plans. A small cluster of tactical questions (N = 14) pertained to planning information, and this cluster contained two subclusters. One subcluster dealt primarily with defensive plans for weapons and electronic warfare use. The second subcluster was terrain related and included route, obstacle, and range planning.

Movement. Within the movement cluster (N = 12), one subcluster of information was concerned with time and distance factors. A second subcluster was concerned with the movement of logistical assets.

Projected Quantity/Time. One small cluster of tactical questions (N = 11) dealt with projected quantities and time information. Projected quantities were related to casualties, refugees, force ratio, and drop zones. The subcluster of information concerned with time included questions about engineers and attack routes.

Logistics. Information contained in this cluster (N = 9) dealt with vulnerabilities, and priorities.

Activity. These questions (N = 7) dealt with artillery, terrain, special weapons activities, as well as priorities for activities.

Friendly Information Portrayal Deficiencies. Table 9 provides a summary of the graphic nature of the friendly information data. The table is organized by cluster and provides the number of questions in each cluster as well as the percentage of questions which survey participants classified as obvious, obtainable, or unavailable from a display with conventional symbology. In addition, the table provides the frequency of use of personalized portrayal methods.

The results of this survey indicate that nearly one-half of the friendly information is unavailable from a display with conventional symbology. Thus, this result localizes one major deficiency of the FM 21-30 set. Otherwise, there are a number of similarities between this analysis and that of the enemy information. The majority of the information characterized as obvious is found in the location cluster (unit related) as is the majority of the information characterized as obtainable by inference (terrain related). A large portion of the information characterized as unavailable is again found in the status cluster, as dynamic information if not portrayable with FM 21-30. Overall, roughly the same percentage of survey participants reported using a personalized method to portray

TABLE 9

FRIENDLY INFORMATION PORTRAYAL DEFICIENCIES

INFORMATION CLUSTER NAME	NUMBER OF QUESTIONS	From a display with conventional symbology, the information is: OBVIOUS	OBTAINABLE	UNAVAILABLE	Percent of requested information portrayed with personalized methods
Status					
Logistics and Time Location Information	77	14%	22%	64%	42%
Non Logistical Information	34	24%	18%	59%	35%
Location					
Unit Related	55	51%	24%	25%	18%
Artillery/Air Defense Weapons	16	44%	31%	25%	13%
Terrain Related	11	27%	55%	18%	27%
Availability/Assets	47	21%	21%	58%	32%
Air Attack	18	22%	50%	28%	39%
*Capability	17	23%	12%	65%	18%
Plans	14	28.5%	28.5%	43%	36%
Movement	12	8%	50%	42%	42%
Projected Quantity/ Time	11	18%	9%	73%	18%
Logistics	9	11%	11%	78%	44%
Activity	8	50%	12.5%	37.5%	13%
	329	27%	24%	49%	28%

friendly information (28%) as did participants to portray enemy information (27%, see Table 7).

Friendly/Enemy Information

Unlike the previous analyses, each question contained in this analysis pertained to both enemy and friendly information. The cluster analysis conducted on the 68 tactical questions which pertained to both friendly and enemy information produced three major information clusters. Table 10 provides an overview of these clusters in terms of the frequency of questions and information content of each cluster.

Attack/Location. More than half of the 68 questions were found to form one cluster (N = 36) which pertained to attack and location. The attack subcluster dealt with time and threat plans or indications. The second subcluster was concerned with the location of vulnerabilities, targets, attack, and surveillance.

Status. The second cluster of friendly/enemy information contained questions pertaining to status (N = 23). One subcluster of questions dealt with the status of weapons and attack. Generally, the questions in this subcluster dealt with quantity information. Two questions dealing with special weapons were weakly related to this subcluster.

Weapons. The third cluster in this analysis contained questions (N = 8) concerned with weapons. Specifically, questions dealt with weapon types and capability.

Friendly/Enemy Information Portrayal Deficiencies. Table 11 provides an overview of the 68 tactical questions which referred to both enemy and friendly information. The table is organized by cluster and provides

TABLE 10

OVERVIEW OF FRIENDLY/ENEMY CLUSTER ANALYSIS RESULTS

INFORMATION CLUSTER NAME	FREQUENCY OF QUESTIONS	CONTENT OVERVIEW
Attack/Location	53%	Location of attack, vulnerabilities, surveillance, targets, attack time and threat plans or indications.
Status	33%	Status of weapons, personnel, air defense; effect of activities or attack upon status.
Weapons	14%	Weapon capability and type.

TABLE 11

FRIENDLY/ENEMY INFORMATION
PORTRAYAL DEFICIENCIES

INFORMATION CLUSTER NAME	NUMBER OF QUESTIONS	From a display with conventional symbology, the information is:			Percent of requested information portrayed with personalized methods
		OBVIOUS	OBTAINABLE	UNAVAILABLE	
Attack/Location	36	31%	36%	33%	25%
Status	23	9%	38%	53%	38%
Weapons	9	11%	22%	67%	11%
	68	21%	35%	44%	27%

the graphic classification data obtained from survey participants. As in the previous analyses, status information was classified as being highly unavailable in a display with conventional symbols.

Information Not specified as Friendly or Enemy

The 50 questions contained in this analysis did not directly pertain to either enemy or friendly information. Table 12 contains an overview of three major clusters identified in the analysis.

Status. More than half of the 50 questions were classified in one cluster (N = 27), and pertained to status information. Within the status cluster there were two subclusters. One subcluster dealt with civil affairs information such as the impact of refugee situation. The second subcluster of information pertained to terrain information. Weather information, such as wind direction and forecast was included in the subcluster, as well as route and trafficability information. Also, detailed terrain information, such as tree heights and soil conditions, was included in the subcluster.

Location. Location information was the predominant feature of another cluster of tactical questions (N = 15). Within the location cluster there were two weakly related subclusters. One subcluster dealt with route location information. The second subcluster was concerned with obstacle locations, and the locations of special weapons activities.

Availability. The third cluster of information was predominated by the concept of availability (N = 8). Within this cluster there two weakly related subclusters. One subcluster dealt with the availability of cover and concealment. The second subcluster pertained to the availability of civilian materials for military use.

TABLE 12

OVERVIEW OF CLUSTER ANALYSIS NOT
SPECIFIC TO ENEMY OR FRIENDLY FORCES

INFORMATION CLUSTER NAME	FREQUENCY OF QUESTIONS	CONTENT OVERVIEW
Status	54%	Current situation concerning civilian populace (e.g., refugees); terrain related information such as weather, trafficability, and terrain details such as tree heights and soil conditions.
Location	30%	Location of routes, obstacles, and special weapons activities.
Availability	16%	Availability of cover and concealment; availability of civilian materiels.

Information Not Specifically Enemy or Friendly-Portrayal Deficiencies. Table 13 provides an overview of the 50 tactical questions which did not specifically refer to either enemy or friendly information. The table is organized by cluster and provides the graphic classification data obtained from survey participants. Most of the information examined in this analysis was classified as being unavailable in a display of conventional symbols. As in the other three analyses, status information was viewed as highly unavailable.

CONCEPTS ABSENT FROM FM 21-30

The military concepts found in the information requirements which are not contained in FM 21-30, but are being graphically portrayed in the field, are discussed below. The major concepts derived from the cluster analysis include status, capability, availability, threat, and logistics. Additional concepts were chosen for discussion on the basis of their high incidence of personalized portrayal. The similarities and differences among the various concepts have been noted in the discussions to follow, and many of the personalized methods for portraying the concepts are described.

Status. Status was found to be an important concept in each of the cluster analyses reported above. The concept of status refers to the current state of affairs or situation. Status is a term that may be applied to units, ammunition, weapon systems, as well as roads and bridges. Status is a state; but it is a dynamic concept in that it requires frequent updating. Numerous survey participants stressed the fact that in an actual combat situation, they would ask the same status questions repeatedly, due to the likelihood of frequently changing answers to the questions.

TABLE 13

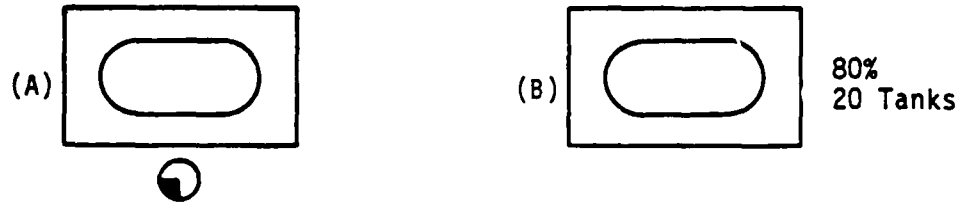
INFORMATION NOT SPECIFICALLY ENEMY
OR FRIENDLY PORTRAYAL DEFICIENCIES

INFORMATION CLUSTER NAME	NUMBER OF QUESTIONS	From a display with conventional symbology, the information is:			Percent of requested information portrayed with personalized methods
		OBVIOUS	OBTAINABLE	UNAVAILABLE	
Status	27	7%	15%	78%	30%
Location	15	20%	33%	47%	67%
Availability	8	28.5%	28.5%	43%	29%
	50	14%	23%	63%	40%

FM 21-30 does not provide guidance to users wishing to portray status, nor does FM 101-5-1, Operational Terms and Graphics (Department of the Army, March 1980). Without a graphic standard to follow, many users have developed methods to graphically portray the information. In fact, within our survey, status was the concept most frequently portrayed with a personalized technique.

The methods used to portray status vary considerably. While some users list status on a chart or table next to the display, others portray the information directly on the display. In order of frequency, the following techniques were noted to portray status: color coding plus alphanumeric notation; alphanumeric notation alone; color coding alone; symbol shape alteration; symbol shape alteration plus color coding plus alphanumeric notation.

To illustrate the variety of methods used, two conventional armor symbols are shown below, and the annotations represent the techniques employed by two survey participants to portray status.



Status information about units typically portrays an assessment of unit strength. The annotation on Figure A indicates that the unit has 25% strength in personnel and equipment; that is, one-quarter of the circle is blackened. Many of the personalized techniques employed to portray status involve noting percentage figures adjacent to symbols, as in Figure B. In some instances, only one percentage is noted to represent overall strength. In another case, three estimates were placed below the symbol to indicate the strength of equipment, systems, and TOWs. In

one example, a survey participant divided a standard symbol into four quadrants representing ammunition, personnel, POL, and weapons. Each quadrant was represented by a different color which had four gradations to portray strength (i.e., 0 - 25%, 26 - 50%, 51 - 75%, 76 - 100%).

It is obvious that status may be portrayed by a wide range of techniques. The techniques also vary in terms of the amount of detail portrayed and the complexity of the method. For example, Figure A, though abstract, is a very simple form, and the annotation reflects an overall estimate. Thus, in Figure A you would not be able to identify specific deficiencies within the unit (e.g., ammunition). Figure B provides the same overall estimate as Figure A, with the additional information on major equipment. In addition, the annotation of Figure B is unlikely to be misunderstood since it is explicit, but, it might present problems of clutter since it requires more space. More complex methods, such as the color coding of our quadrants of a symbol, may increase the likelihood of misinterpretation of the meaning. The complex technique, however, does provide more specific information, and does not require the addition of information outside the symbol.

The frequent need by users for status information seems obvious; status is required information to evaluate the current battlefield situation. Yet, a graphic display of status has not been part of advanced systems such as TOS or BETA Test Bed.

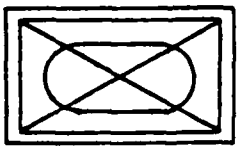
Capability

The concept of capability pertains to the potential of an entity, whether the entity is an Army, a unit or a weapon. Unlike the concept of status which asks the question "what is it doing now?", capability asks "what can it do?" The majority of tactical questions which dealt with

capability concerned enemy information; capability information concerning friendly forces was generally logistical information and was contained on charts, not in graphic displays.

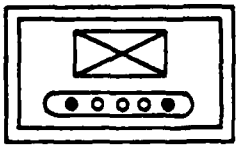
The cluster analysis of enemy information suggests that capability is related to the concept of threat. For example, a nuclear capable artillery unit was found as part of threat within the capability cluster. The personalizing of such capability information would be to distinguish the units which had a certain capability from those who did not have that capability. In this example, color coding was used to denote the nuclear capability. The concept of capability was also part of a cluster of enemy information dealing with type information. The type cluster contained very detailed information, such as type of vehicle and type of ammunition. While yes/no answers were sufficient for many of the threat capability questions, more detail was required for the type capability questions.

Various methods for personalization of detailed capability information were observed. As an example, the generic type of vehicles in an enemy unit was shown in the following manner:



BMP

Also, specific types of bridging capability were shown by adding information to the interior of a standard symbol, such as:



Additional capability information requirements dealt with special weapons information, such as a nuclear or a chemical capability. This information also does not have a standard for portrayal at present, and FM 21-30 does not offer guidance for distinguishing nuclear capable units, or chemical capability. Thus, this information is being portrayed with personalized methods. The capability of weapons systems was frequentrly portrayed adding range fan to the standard symbols.

This brief discussion shows how capability information may be portrayed at various levels of information detail, depending on a particular user's needs. Therefore, creation of a standard method of portrayal for the capability concept must acknowledge these various levels of detail if it is to suit the variety of user requirements.

Availability

The concept of availability relates to the presence and readiness for use of an entity, such as ammunition, or fire support. From the cluster analyses, availability deals primarily with friendly information, but availability was also found in the cluster analysis which did not relate to enemy or friendly information. In the latter instance, availability pertained to the terrain as well as civilian materiels. The concept of availability has no method of portrayal according to the current graphic standards, but availability information is portrayed on some displays, through the use of personalized methods.

Availability concerning friendly information typically requires number and time data. For example, the availability of close air support is dependent upon the quantity and time availability of certain aircraft. Alphanumeric notation was most frequently used to modify conventional symbology to portray the availability concept. The availability of

ground units was, in some instances, displayed with color coding. In this case, units which could most quickly relocate were color coded in such a way as to distinguish them from the other friendly units.

The portrayal of availability concerning terrain information was also generally accomplished with color coding. Those areas of maximum cover and concealment were highlighted to distinguish them from other areas, and available civilian materiels were identified through marking or highlighting the relevant areas.

Threat

Threat concerns vital battlefield data and is composed of various types of information including capability, status, and doctrine, among others. The information obtained from the survey included both threat and the various information types which comprise threat. Currently, there are no graphic standards available for the portrayal of threat.

The portrayal of enemy threat had been the focus of an experimental symbology termed Combat Power Symbology (CPS). CPS mapped gradations of the threat potential of enemy units to the perceived threat inherent in various geometric shapes. For example, a diamond shape was perceived as the most threatening geometric form and this form was then paired with enemy armor units. This symbology development offers an interesting approach, namely, representing two dimensions of unit information in a single shape. Specifically, the symbol shape (e.g., diamond) conveys both identification information (e.g., armor) as well as threat potential (e.g., most threatening). One problem with this method is that the potential threat displayed by CPS was based on full unit capability; thus, there was no provision for updated, dynamic information based on activities or losses which might effect the threat potential estimate.

In addition to the dynamics of threat, there is a differential user perspective which must be considered in the portrayal of threat. Threat units may not be the same for all users. For example, while an enemy armor unit may be most threatening to a ground unit, it may not be seen as a major threat to an air unit. Thus, the planners of the air unit missions might view other types of units as the most threatening.

Thus, the concept of threat represents complex information in that the identification of a major threat is based upon highly processed and summarized information. It was often the end product of such analyses that users displayed in the current investigation. The method of display was usually simple, either by color coding or by increased symbol size to denote a major threat. Given the consideration of users perspectives and the dynamics of changing battlefield situations, a standard method of displaying threat might be useful.

Logistics

A major cluster of friendly information dealt with the status of logistical information. While the concept of status has been discussed previously in this section, logistics is being treated separately due to the apparent importance of the information. The need for logistical information was a concern to a wide range of tactical personnel; it was not restricted to the logisticians interviewed.

The logistical information contained in FM 21-30 deals only with the identification of installations and depots, and in some instances, more information is needed to reflect accurate identifications. For example, ammunition depots may need to be differentiated from one another to reflect the various types of ammunition contained in them. In such cases, informal standards may evolve to meet the needs.

Additional logistical information requirements pertain to status information. Users surveyed were often displaying percentages of fuel, ammunition, and spare parts in an effort to portray logistical status. While alphanumeric notation was generally used to display the logistical information, color coding was also employed by some participants.

Additional Concepts

In addition to the major concepts mentioned above, there are several other types of information that are being portrayed with personalized methods but for which FM 21-30 does not provide portrayal guidance.

Activities. There is a limited amount of activity symbols available in FM 21-30, such as ambush, firefights, and harassing fire. However, types of activities are also being portrayed with personalized techniques. These include intense contact points, weighted attacks, intentions and indications of actions, as well as those units which are deployed.

Civilian Affairs. There were few information requirements which pertained to civilian affairs. However, the questions which were asked came from a variety of users. Evacuation assessment, displaced persons holding areas, and civilian casualties were among the information being portrayed with personalized methods. One user noted "representation of civilian and refugee movement is much neglected and requires new symbology."

Communications. Communications and electronic warfare, though not appearing as major information clusters, represent information which has a limited amount of standard symbols. The communication symbols contained in FM 21-30 deal with various types of equipment, but user information

requirements concerning communications deal with a variety of other aspects. For example, communications information about friendly forces did not pertain to equipment at all. The types of information that concerned the users most were the existence of secure communications, and the identification of those units in contact. Both of these types of information were portrayed with personalized methods using color coding.

Much of the communications/electronic warfare information pertained to enemy information. The variety of information included the type, amount, and pattern of communication traffic, as well as the type, movement, and activities of SIGINT/EW, and the enemy electronic order of battle. All of the information noted was displayed with personalized portrayal methods including the creation of new symbols and alphanumeric notation.

Enemy Formations. A few information requirements obtained in the survey dealt with the formations of enemy units. Currently, there are no standard symbols to indicate the formation of units. In one instance, Soviet symbols were employed by a user to portray formations while another user employed color coding.

Range Fans. The range of weapons and units is an important battlefield concern. While many users employ range fans to display the danger area around weapons and units, FM 21-30 and FM 101-5-1 do not address the portrayal of the range information. In one instance, a user employed color coding. With this method, colors were assigned to certain weapons (e.g., red for Dragon, purple for TOW). Since range fans are the most common method of display, a standard range-fan symbol for portraying range information might be useful.

2nd Echelon. Numerous information requirements concerned location, action, and composition of the enemy 2nd echelon, and most of the information concerning the 2nd echelon is being displayed with personalized methods. Generally, alphanumeric notation and shape alteration are used to distinguish the 2nd echelon forces from the other enemy units. Because of the importance of the 2nd echelon force, creation of a standard for its portrayal would be useful.

Personalized Portrayal Methods -- QDF Findings

Information characterized by participants as unavailable on a display was most frequently portrayed with personalized methods, and some of the information that users considered to be obvious on a display also were personalized. While some of the information classified as obvious and personalized is not available in FM 21-30, other obvious information is available in FM 21-30 but may require modification to fit the specific needs of the users.

The use of personalized portrayal methods is very much a matter of individual preference. Some survey participants personalized most of their information requirements, while a few personalized very little. In some cases, survey participants seemed to have a strong preference for "seeing" information they considered important on a display; these individuals were apt to employ the personalized methods when conventional symbology did not fulfill their needs.

Survey participants who indicated the use of a personalized portrayal method were also asked to complete additional questions on the QDF to identify the type of personalized technique employed. In a number of

instances the personalized technique involved the creation of new symbols. Most often, however, participants were modifying conventional symbology.

In an effort to detail personalized portrayal methods, survey participants were asked to characterize their method by the following techniques:

(1) Alphanumeric notation.

(2) Color coding.

(3) Symbol shape alteration.

(4) Combinations of the above techniques.

(5) Other techniques.

A frequency count of the techniques used to portray the personalized information requirements produced the following: alphanumeric notation 29.5%, color coding 10%, symbol shape alteration 14.5%, combinations of the above 25%, other techniques 21%.

Alphanumeric Notation. Alphanumeric notation was the technique used most frequently by survey participants in their personalized portrayal methods. Unlike graphic techniques such as color or dashed lines, FM 21-30 does not offer specific guidelines concerning the use of alphanumerics. However, alphanumerics are utilized in FM 21-30 to represent the following information:

(1) Unit designation (e.g., A/2-15).

(2) Unit function (a few units are represented by abbreviations, such as MI for military intelligence).

(3) Additional identifying information about a unit (such as VUL below a symbol to indicate a Vulcan with the unit).

(4) Date time group.

(5) Objectives.

(6) Control measures.

Survey participants have employed alphanumeric notation to portray a broad range of information (see Appendix C for complete list). Examples of the various information portrayed with alphanumeric notation will serve to demonstrate this point. Alphanumeric notation was employed by survey participants to portray a range of information from threat and capability to supply rates. The overall status of a unit might be noted by a percentage figure next to the symbol. Numeric estimates of time and distance figures might be found adjacent to those friendly units which could be used to counter enemy moves. The nuclear capability of enemy units also was identified with alphanumeric notation.

In a few instances, alphanumeric notation was used to portray information for which FM 21-30 has symbols. Specifically, FM 21-30 contains symbols for anti-air and anti-tank weapons, but alphanumeric notation was used by some participants to portray these weapons. A likely reason for the modification is that the level of detail of the FM 21-30 symbol was not considered adequate.

The latest revision of FM 21-30 occurred in 1970. Since that time, new equipment, units, and weapons have been added to the battlefield. When new elements are introduced which do not have standard symbol representation, alphanumeric representation seems to be a commonly accepted solution. For example, the combat electronic warfare intelligence unit does not have a symbol in FM 21-30, it appears to have become common practice to place the abbreviation (CEWI) in a rectangle which becomes the symbol.[5] One survey participant noted a similar symbol evolution for portraying fast scatterable mines and modular man-packed minefields. Thus, in the absence of standard symbols, the abbreviations or acronyms, such as FASCAMS or MOMPMS respectively, evolve as an informal standard for some users.

Alphanumeric notation would appear to be used rather extensively in a number of circumstances. Alphanumeric notation is likely to be used to portray new units, equipment or weapons which do not have representation in FM 21-30. Also, alphanumerics may be used to represent concepts, such as status, which do not have a standard method of portrayal. Finally, alphanumerics may be employed to supplement FM 21-30 symbols in order to convey identification type information at the user's desired level of information detail.

Color Coding. The color coding standards of FM 21-30 designate the use of four colors in conjunction with military overlays and symbols.[6]

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[5]This portrayal of CEWI has been incorporated into the BETA Test Bed and NATO D-49 (1980).

[6]The use of other colors is acceptable according to FM 21-30 if an explanation in the legend or margin of the overlay is provided.

The colors specified and their associated meanings are as follows:

(1) Blue -- Friendly units, installations, equipment, and activities.

(2) Red -- Enemy units, installations, equipment, and activities.

(3) Yellow -- Friendly or enemy areas of chemical, biological, or radiological contamination.

(4) Green -- Friendly or enemy man-made obstacles.

Survey results indicate the use of color coding for a considerable range of information beyond the information specified by FM 21-30 (see Appendix C for complete list). A variety of terrain features, such as avenues of approach, trafficability, high ground, and key terrain, are distinguished with color coding. Color coded dots have been used to highlight the location of enemy air strikes.

In some cases, color coding was used to identify information which is binary in nature. For example, color coding was used to distinguish friendly units within communication contact as well as to distinguish enemy units which were nuclear capable. Major threat units were distinguished from lesser threat units by utilizing bold or light colors. The use of bold and light colors was also employed to differentiate known from suspected enemy locations.

The portrayal of weapon range utilized color coding in a couple of different ways. In one method, color coded range fans extended from the unit symbols. In another method, specific lengths of color coded lines (e.g., red, blue, and purple) extended from weapons (e.g., Dragon, M60, and TOW) to portray their individual ranges.

Frequently, the portrayal of status information was accomplished with the use of color coding. In some cases, participants were portraying an overall single estimate of unit status with color coding. In one instance, a more detailed method was employed. Specifically, a unit symbol was divided into four sections, each color coded to represent ammunition, POL, personnel, and weapons. To portray the status of the four elements, four levels of each color were used to represent estimates of strength (i.e., 0 - 25%, 26 - 50%, 51 - 75%, 76 - 100%). Though this method was rather complex, it provided a considerable amount of information within the confines of the basic symbol shape.

The examples presented provide evidence that color coding has been used to portray a range of information beyond the guidance specified by FM 21-30. Color coding may be employed for emphasis, such as major threat, or color may be used to express detail information, such as ammunition status.

Symbol Shape Alteration. Rectangles, circles, and triangles are the primary symbol shapes provided in FM 21-30.[7] The shape of the FM 21-30 symbols conveys functional distinctions between units (rectangles), installation (circles), and observation posts (triangles). From the survey results, it is evident that modifications are being made to symbol

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[7]There are two additional symbols used for specific Combat Service Support unit (see FM 21-30, pp. 2-4).

shapes to convey additional distinctions (see Appendix C for complete list). Fan shapes, for example, may be added to the symbol to represent the effective range of the unit's weapons. Currently, a standard method for portrayal of weapon range is not available in either FM 21-30 or FM 101-5-1; the concept is, however, frequently portrayed.[8]

A rather simple shape modification employed by some survey participants involved varying the actual size of the symbols. Major enemy threat units, for example, could be emphasized by portraying them with oversized symbols. This same technique, namely oversized symbols, was used to portray known enemy unit locations, as well as the location of a weighted enemy attack. The concepts these users were portraying may be somewhat related. Enemy threat, known locations, and weighted attack are not the same concepts, nor are the concepts dealing with the same level of information detail. The concepts are, however, being portrayed in the same manner.

Some alterations of symbol shape that were identified in the survey involved adding other symbols to the standard symbols in order to portray the information. To indicate bridging assets, one user added an additional symbol to the interior of a unit symbol to portray the information. In another instance, a user added symbols below the unit symbol to indicate the strength of various friendly units elements, such as TOW strength, tank strength, etc.

In addition to the alteration of the core symbol shape, the shape of subelements, such as arrows, also were modified. According to FM 21-30, arrows are used to portray movement, and results of this survey indicate

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[8]Combat Power Symbology (an experimental symbology developed at USAICS) offers a weapon range fan symbol.

the use of arrows is generally concerned with movement. Frequently, the only modification to the arrows involved the addition of numbers to indicate the rate of movement. There were instances, however, where the relationship between the arrow and movement was rather vague. In one case, a modified arrow () was placed below a unit symbol to indicate threat tanks forward. In another case, a solid arrow was used to represent definite enemy intentions, and a dotted arrow represented possible enemy intentions. In both cases, the concepts being portrayed could relate to movement, though not necessarily. In another instance, a broken arrow was used to draw attention to enemy vulnerabilities, notes in the margin of the overlay provided the explanation. In this case, the purpose of the arrow was to draw attention to the information not to display movement.

As previously stated, the use of the circle and triangle convey a distinct meaning according to FM 21-30, namely to identify installations and observation posts. These shapes may, however, be used for different meanings. Specifically, one user noted that on a nuclear target overlay circles are used to represent nuclear targets and triangles represent chemical targets. Whether the use of circles and triangles in this manner is common practice is not known. The survey participant who noted this method, indicated that there was an absence of standard symbols for nuclear and chemical targeting.

Thus survey results about symbol shapes indicate that in some instances different meanings are portrayed from those intended in FM 21-30. Whether this creates symbol shape misinterpretations is not known, but the likelihood of such an event seems well within the realm of plausibility.

Combined Techniques. Survey participants used various combinations of alphanumeric notation, color coding, and symbol shape alteration to portray information. One-fourth of the information portrayed with personalized methods involved the use of combined techniques (a complete list may be found in Appendix C). In some instances, a survey participant had employed combined techniques to portray information that another participant had shown with a single technique.

The range of information types portrayed with combined techniques was rather extensive; a few examples help to illustrate this point. A combination of color coding, shape alteration, and alphanumeric notation was used to indicate enemy electronic countermeasure capability, range, and time of use. Color coding and shape alteration were employed to show the formation of enemy lead elements. Enemy egress routes were displayed with color coding and alphanumeric notation. The status of friendly unit personnel, equipment, POL, and ammunition was also displayed with color coding and alphanumeric notation. Shape alteration and color coding were combined to portray enemy historical events. Information portrayed with combined techniques ranges from detailed time/distance factor estimates to summarized information such as enemy activity.

Other Techniques. The classification of "other" techniques was used by survey participants when shape alteration, alphanumeric notation, or color coding did not describe the personalized method employed. Nearly half of the "other" techniques involved the use of charts. The remainder of the techniques included the development of new symbols, templates, or overlays (see Appendix C for complete list). The use of charts is of particular interest in that the information content of many of the charts is strikingly similar to some of the information portrayed graphically. For example, ammunition status was noted by one survey

participant on a chart while another individual portrayed the information with symbol shape alteration and alphanumeric notation.

Frequently, survey participants developed overlays to portray their information requirements. Salient terrain features and weather were among the information portrayed as well as reconnaissance and patrolling plans.

In a number of instances, survey participants developed new symbols to portray their information requirements. One participant, for example, developed a symbol to display an estimate of enemy communication traffic. Soviet symbols were employed by one participant to display enemy formations. One survey participant noted the use of "Decision Graphics,"[9] a non-standard symbology, to portray enemy formations.

Summary of Personalized Methods. The preceeding discussion highlighted the range of information which participants in this survey have portrayed with personalized methods. An obvious conclusion might be that adherence to the graphic standards of FM 21-30 is not the order of the day. Though this conclusion may be accurate, it does not imply that FM 21-30 is totally unsuitable. The symbols of FM 21-30 permit identification and designation of battlefield elements such as units and vehicles. In a sense, FM 21-30 provides nouns, and the information which survey participants have portrayed with non-standard techniques are the modifiers and verbs.

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[9] A discussion of decision graphics may be found in a paper presented by General Paul Gorman, entitled "A Command Post Is Not A Place."

While the purpose of a battlefield graphic display may typically be to "see the battlefield," this involves more than identifying the function and location of units. Different individuals wish to "see" different aspects of the battlefield. Some survey participants appear to use their graphics in an alerting capacity. For example, survey participants noted that some information would be portrayed only if it were unusual, such as unusual enemy communication equipment. The implication is that the information, when portrayed, served as an alert. The distinction between major and lesser enemy threat units might also serve as an alert. Other types of information might serve different functions: status, for example, might aid decision making.

A cross-technique comparison was made of the information survey participants were portraying in non-standard ways. The purpose of the comparison was to identify information which has been portrayed with more than one technique. The comparison results are presented in Table 14. Considering the vast amount of information which was portrayed with the various techniques, it might be surprising that the list is so small. The reason for the small number of instances of alternative techniques for coding the same information is found in the level of information detail individuals portray. Within the user community surveyed, there are numerous concepts which may have have shared meanings, yet it does not necessarily follow that the level of information detail is also shared. The concept of status, for example, may have a shared meaning, yet POL status and friendly unit status vary in terms of their information detail. User perspectives may differ so that two individuals needing status information may require different levels of detail upon which to base their analyses and decisions.

Table 14 summarizes the numerous information types that are being portrayed in a variety of ways. Threat, for example, was shown on a

TABLE 14

CROSS-TECHNIQUE COMPARISON OF
PERSONALIZED INFORMATION

	ALPHA-NUMERIC NOTATION	COLOR CODING	SYMBOL SHAPE ALTERATION	COMBINED TECHNIQUES	CHART	OVERLAYS/ NEW SYMBOLS
AVENUES OF APPROACH	✓	✓		✓		✓
CHOKE POINTS	✓		✓			
FORCE RATIO	✓			✓	✓	
HIGH COMBAT INTENSITY AREAS			✓	✓		
ROUTES	✓	✓		✓		
SALIENT TERRAIN FEATURES		✓		✓		✓
TRAFFICABILITY		✓		✓		
WEATHER (RELATIVE TO OPERATIONS)	✓					✓
ENEMY INFORMATION, SUCH AS:						
ACTIVITY	✓		✓		✓	
ATTRITION	✓				✓	
FORMATIONS				✓		✓
KNOWN LOCATIONS		✓	✓			
MOVEMENT	✓		✓			
NUCLEAR CAPABILITY	✓	✓				
STRENGTH	✓			✓	✓	
TASK ORGANIZATION	✓			✓		
THREAT	✓	✓	✓		✓	
WEAPON RANGE		✓				✓
WEIGHTED ATTACK LOCATION		✓	✓			✓
2ND ECHELON COMMITTMENT			✓	✓		
FRIENDLY INFORMATION, SUCH AS:						
ATTACK HELICOPTER STATUS		✓			✓	
AMMUNITION STATUS				✓	✓	
CLOSE AIR SUPPORT AVAILABILITY	✓				✓	
OBSTACLE STATUS	✓			✓		
PERSONNEL/EQUIPMENT STATUS		✓		✓	✓	
POL STATUS				✓	✓	
TASK ORGANIZATION				✓	✓	
TIME/DISTANCE FACTORS	✓					✓
UNIT STATUS (GENERAL)	✓	✓			✓	
WEAPON RANGE		✓	✓			
WEAPON STATUS		✓			✓	

display by using alphanumeric notation, color coding, symbol shape alteration, or a chart. The possibility arises that the user of one technique will not recognize the same concept when portrayed with another technique. This is probably the greatest problem with the use of personalized methods -- each individual may understand their meanings but another may not. Hence, the value of the graphic displays as a method for conveying an immediate impression of a vast quantity of information is diminished.

CONCLUSIONS AND RECOMMENTATIONS

FM 21-30: NEED FOR AN UPDATE

Conventional military symbology, as portrayed by FM 21-30, has been characterized as having been "designed for an era of more time and less information.[10] The results of the current user community survey demonstrate the need for an FM 21-30 update.

Conventional symbology appears adequate for the purpose of identification and designation of many battlefield concepts; but one emerging problem is the overreliance on abbreviations and acronyms to portray new entities. In addition, as indicated by the survey, alphanumeric notation is the most frequently used technique to modify the conventional symbols. The overall impact that alphanumerics may have on tactical displays is not known but certain questions warrant explorations:

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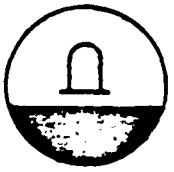
[10] "A Command Post" is not a Place," Concept Paper by General Paul Gorman.

(1) When displayed together, will numerous alphanumerics distract from the somewhat abstract conventional symbols?

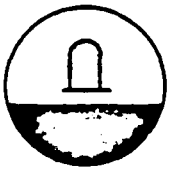
(2) Is alphanumeric information more confusing or difficult to find in a cluttered display?

(3) Is alphanumeric information the most meaningful method of portrayal?

Another problem is that some modifications to conventional symbology may increase rather than decrease confusion. For example, the following minor graphic distinction was addressed critically by one participant:



ASP



ATP

The first modification (ASP) represents a depot containing various types of ammunition, the second modification (ATP) indicates a depot containing only main tank ammunition. The survey participant expressed concern that these modifications could easily induce error; such a small distinction might not even be noticed in a cluttered display.

Table 15 shows the key symbology needs identified by the user survey. The left column lists concepts that are not currently symbolized by FM 21-30; the right column indicates frequently used personalized methods of portraying these concepts. The concepts are presented in order beginning with the most frequently needed in the performance of tactical tasks.

TABLE 15

PERSONALIZED METHODS FOR PORTRAYING KEY CONCEPTS

KEY SYMBOLOGY NEEDS	FREQUENT USER REPRESENTATIONS
Status	Alphanumeric Notation New Symbol Color Coding
Capability	Alphanumeric Notation New Symbol Color Coding
Availability	Alphanumeric Notation Color Coding
Threat	Color Coding Symbol Size Alteration
Logistics	Alphanumeric Notation Color Coding
Activities (Enemy Indications and Intentions)	New Symbol
Civilian Affairs	Symbol Shape Alteration New Symbols
Communications	New Symbols Color Coding Alphanumeric Notation
Enemy Formations	Soviet Symbols Color Coding
Range Fans	New Symbols Color Coding
Enemy 2nd Echelon	Alphanumeric Notation Symbol Shape Alteration

In an effort to update FM 21-30, guidelines for symbol development could be derived from observed personalized portrayal methods. Let us suppose, for illustrative purposes, that a standard method for portraying status is to be determined. From the table, it is apparent that there are a number of ways to portray the concept. Figure 3 shows some of the ways users have portrayed status (the color coding method is not included in this example) at various levels of detail. A single overall estimate of unit status is portrayed with symbols A and B. A detailed estimate of status is shown with symbols C, D, and E. From this sample, we see that symbol developers would be faced with two principal choices: (1) whether to use alphanumerics or a gauge-type symbol, and (2) the level of detail to portray. These alternatives could be evaluated empirically to make the choice.

As evidenced by the survey results, there exists a basic conflict between the users need to "see" their information versus the consequence of a lack of standardization. On one side of the conflict, there exists a body of information not addressed by FM 21-30, such as status, capability, and threat, that is being portrayed in a non-standard manner. On the other side of the conflict, non-standard methods may seriously jeopardize the communicative value of the graphics.

The issue of symbology standardization is complex, primarily due to differences in user needs. Some users want a display for specific purposes, such as triggering their memory, or alerting, or as an aid in their decision making. In addition, the level of information detail required by users varies. For example, the intelligence collection manager does not always deal with the same information detail as the G-2. An undesirable effect of standardization would be to preclude users from employing graphics in a way that best satisfies their particular need or orientation. Nevertheless, the complexity of standardization

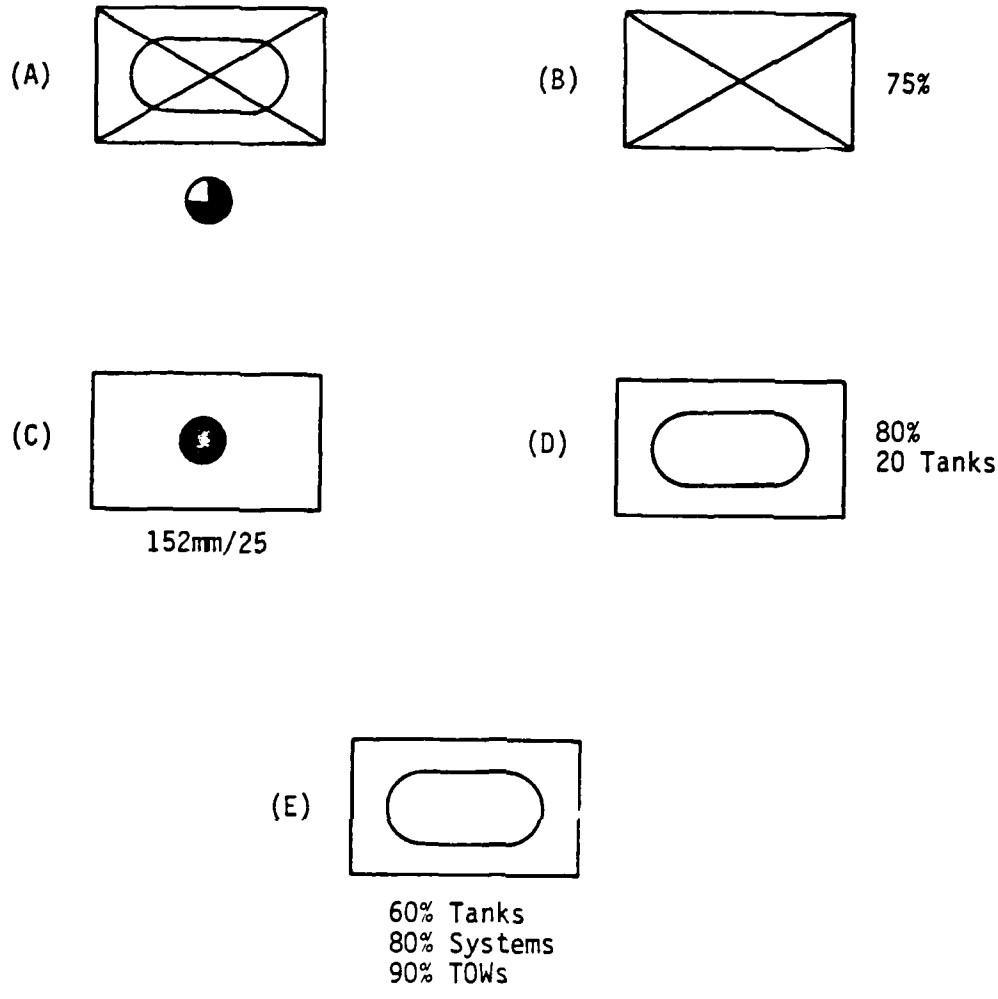


Figure 3. Candidate Methods of Portraying Status

must encompass two user perspectives: the purpose of graphics as well as the information detail needed by the user.

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APPENDIX A

ELICITATION SCENARIOS

NOTE: References to figures and tables within Appendix A refer to those figures and tables supplied in each of the four individual sections of the appendix. The four sections of Appendix A are listed below:

Defensive Operations: European Setting
Offensive Operations: European Setting
Offensive Operations: Middle East Setting
Defensive Operations: Middle East Setting

DEFENSIVE OPERATIONS: EUROPEAN SETTING

DEFENSIVE OPERATIONS
EUROPEAN SETTING

STRATEGIC ENVIRONMENT

Following World War II, Germany was split; the United States, Great Britain, and France captured the western portion, and the Hanslande Republic the eastern segment. The western allies formed the North Atlantic Treaty Organization (NATO) for the stated purpose of maintaining peace through security and defense preparedness. The Hanslande Republic and its allies interpreted the presence of NATO as a threat to their existence; therefore, they entered into a mutual defense unification entitled the Popular Eastern Alliance (PEA). The primary proponents for this pact were the Hanslande Republic (HR), Democratic Feldlande (DF), the Republic of Ostlande (OS), and the Hinterlande Republic.

The reality of deployed NATO and PEA forces in Northern and Central Europe inexorably poses the threat of tension and crisis escalating to war. Combined with military forces of other alliance members, the European theater is composed of large, modern, and potentially destructive forces, unparalleled in the history of warfare.

Northern and Central Europe	NATO	Popular Eastern Alliance
Combat and Direct Support Troops Available	630,000	895,000
Tanks	7,000	19,500
Tactical Aircraft	2,350	4,075
Nuclear Weapons	7,000	3,500

CHRONOLOGY OF EVENTS LEADING TO HOSTILITIES

(1) On 8 August PEA nations initiated full mobilization. Member nations made every effort to limit NATO intelligence operations and thus hoped to complete substantial military preparations without permitting a firm

indication of their intent.

(2) On 9 August, a forthcoming field exercise to test PEA defense plans was publicly announced. A restriction on foreign travel within PEA countries was invoked.

(3) On 10 August, intelligence reports indicated that Hanslande Republic military traffic heading west into Democratic Feldlande was unusually heavy and appeared excessive to the needs of the previously announced field exercise. Supreme Allied Commander Europe (SACEUR) ordered a state of Military Vigilance.

(4) By 11 August, the PEA buildup in Eastern Europe was apparent to the West. Increased rail, highway, and air activities, as well as the arrival of several Hanslande Republic divisions in Democratic Feldlande, had been confirmed. Authority to declare Simple Alert, was requested by SACEUR.

(a) The request was transmitted to the NATO Secretary General, who chaired the Defense Planning Committee (DPC). The permanent representatives to the DPC were polled by the Secretary General. After consulting with their national governments, as well as their permanent representatives to the NATO Military Committee, no objections to SACEUR's request were voiced and the declaration of Simple Alert was authorized.

(b) As a result, SACEUR alerted allied force headquarters in Northern, Central, and Southern Europe. Headquarters, Allied Forces Central Europe (AFCENT), in turn, placed its two Army groups and Headquarters, Allied Air Forces Central Europe (AAFCE), along with its two Allied Tactical Air Forces (ATAFs) on increased alert.

(5) On 13 August, because of increased pace of the PEA buildup, SACEUR issued planning guidance and requested authority to declare Reinforced Alert. The DPC approved the request. Efforts by the United Nations (UN)

to halt the PEA buildup were unsuccessful. Commander in Chief Allied Forces Central Europe (CINCENT) issued his theater guidance.

(6) On 14 August, evidence was received that PEA forces were mobilizing and would soon attack. As a result, SACEUR received authorization from the DPC to declare General Alert. NATO forces began moving to their assigned emergency defense positions. Obstacle construction was initiated. The US Congress declared a state of national emergency and ordered units and members of the Ready Reserve and Standby Reserve to active duty (Section 672, Title 10, US Code). The President ordered the deployment of dual-based forces to Europe. Other NATO nations commenced mobilization at the same time.

(7) On 16 August, Hanslande Republic forces continued to deploy into Democratic Feldlande and Hinterlande Republic.

(8) By 18 August, a major portion of the Hanslande Republic theater reserve forces had arrived in the western section of the Republic of Ostlande where they were deployed along lines of communication that would facilitate their rapid western movement into Democratic Feldlande.

(9) On 20 August, PEA units were detected moving towards the western borders of Democratic Feldlande and Hinterlande Republic. NATO units patrolling border areas reported the evacuation of civilians and other noncombatants.

(10) At 210400 August 1981, armed forces of the Popular Eastern Alliance (PEA) launched a nonnuclear attack against the Central Army Group (CENTAG) region as part of a larger coordinated attack to seize the industrial port complexes in the Northern Army Group (NORTHAG) region. The initial phase of the attack is aimed at destroying Allied defenses in the AFCE area before reinforcements can be effected. A sketch map of CENTAG dispositions is shown in Figure 1.

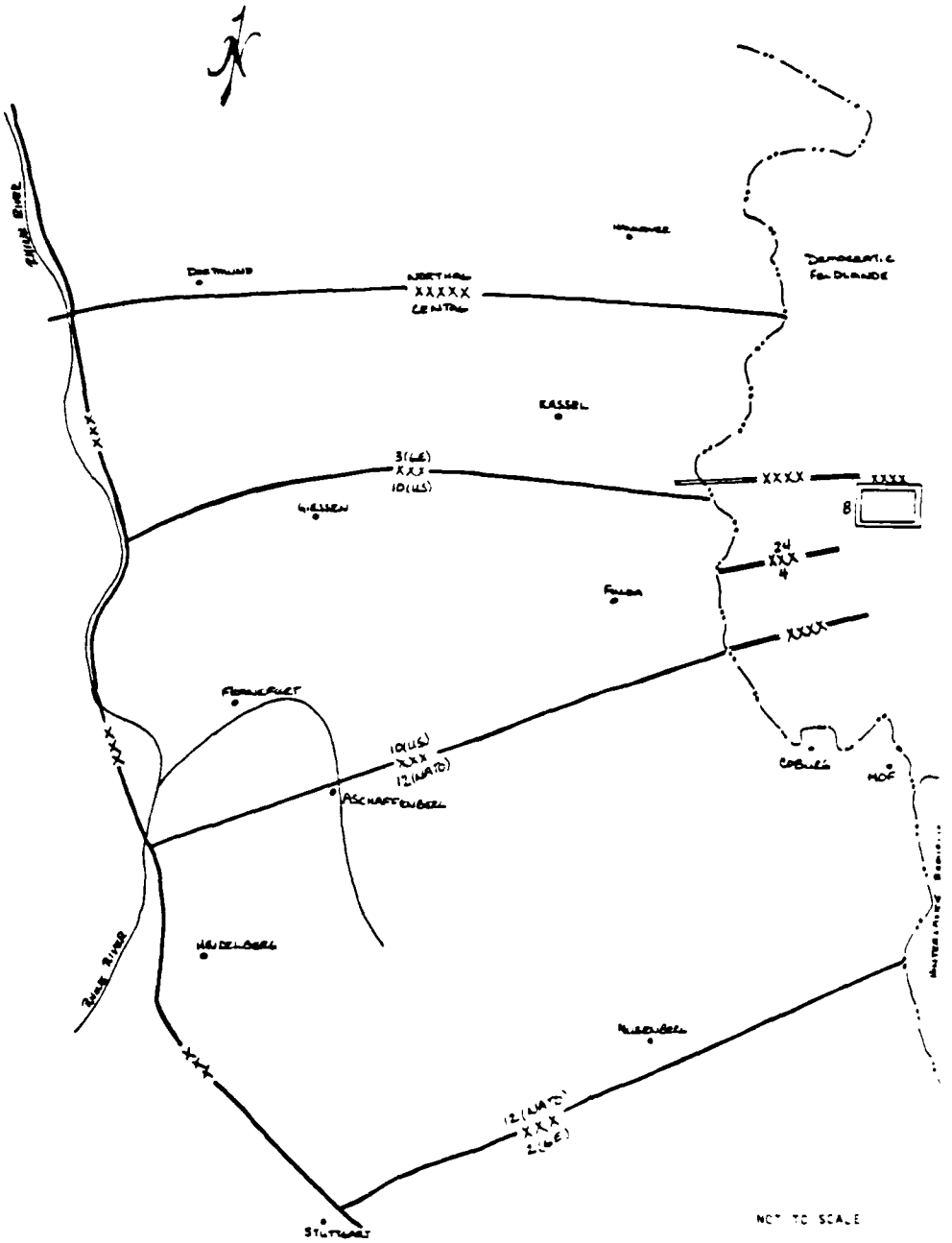

FIGURE 1. SKETCH MAP OF CENTAG DISPOSITIONS

MISSION

On order, 23d Armored Division establishes a covering force along the international border and defends in sector from NB486505 to NB425120, to defeat the first echelon Army forward of Alsfeld.

COMPARISON OF FORCES

Friendly Force:

The 23d Armored Division will be operating as part of the 10th (US) Corps as depicted in Figure 2. The division is at full strength, the task organization is given in Table 1. No major equipment shortage exists. There are no significant maintenance problems. Troops have been undergoing intensive combat training. Morale is good.

Opposing Force:

The forces opposing the 23d Armored Division are elements of the enemy Southern Front. The front is composed of two Combined Arms Armies (CAA), one Guards Tank Army (GTA), one Tactical Air Army (TAA), one Airborne Rifle Division (ARD), and one Artillery Divisions. When the PEA force attacks, the Front first echelon will consist of six motorized rifle divisions and three medium tank divisions. Order of battle information for the Southern Front is contained in Table 2.

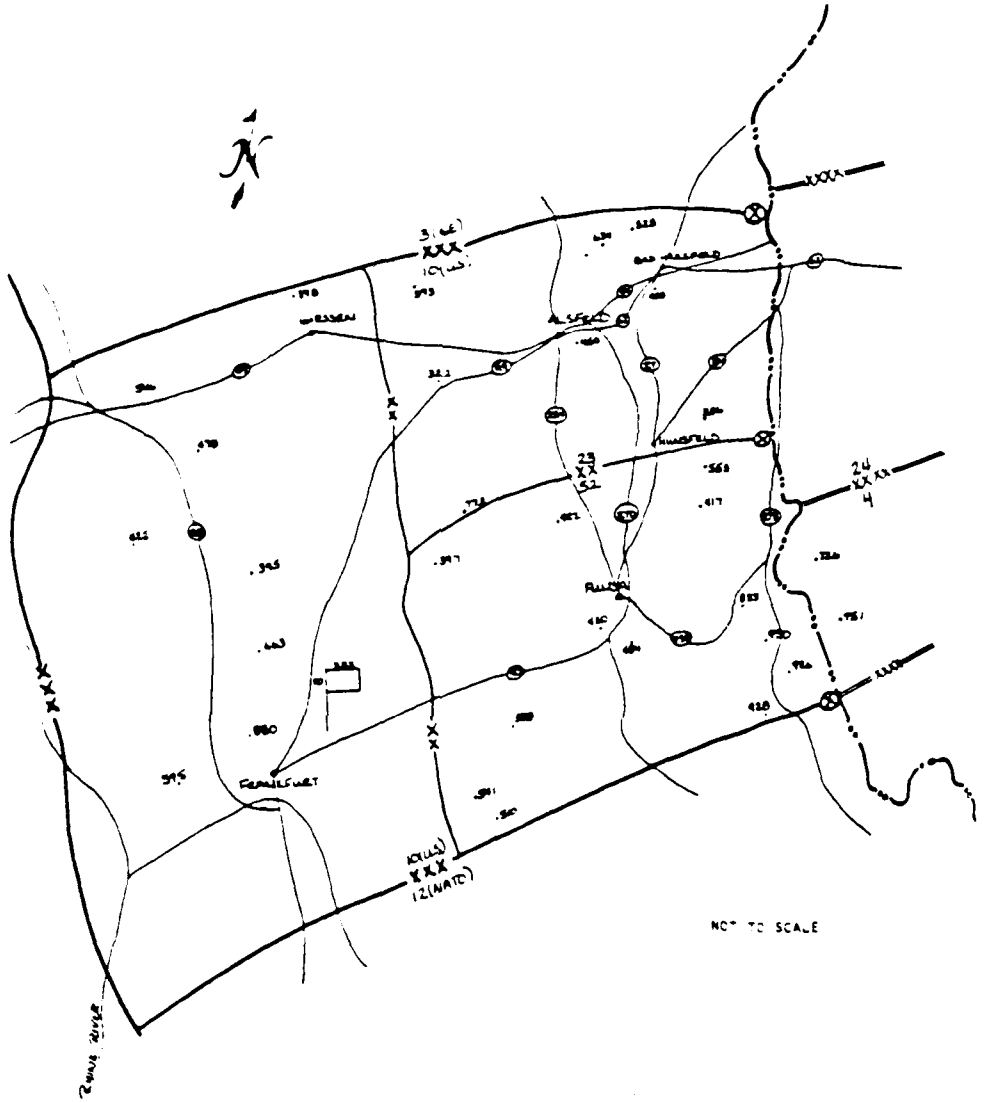

FIGURE 2. CORPS AREA OF OPERATION

TABLE 1

TASK ORGANIZATION

23d ARMORED DIVISION

1ST BRIGADE

- 1-91 Mech
- 1-95 Mech
- 1-13 Armor
- 1-15 Armor
- TF 2-18 Armor (2T, 1M)
- 1-50 FA (DS)
- 1/A/440 ADA (atchd for CFA opn)
- 1/B/23d CEWI
  - (6 GSR Tm, 3 REMS Tm)
- 1 IPW Tm/23d CEWI
- 1 OPSEC Tm/23d CEWI
- A/23d Engr (+) (DS)
  - A/510th Engr Cbt Bn (Corps) (+) (OPCON)

2ND BRIGADE

- 1-92 Mech
- 1-93 Mech
- 1-10 Armor
- 1-12 Armor (-)
- 1-14 Armor
- 1-201 Armd Cav Regt
  - 1/5021 Engr Co
- TF 2-142 Mech (2M, 1T)
- B/1-11 Armor
- 1-51 FA (DS)
- 2/A/440 ADA (atchd for CFA opn)
- 2/B/23d Cewi
  - (9 GSR Tm, 4 REMS Tm)
- 1 IPW Tm/23d CEWI
- 1 OPSEC Tm/23d CEWI
- Task Force 510 Engr (DS)
  - 510th Engr Cbt Bn (Corps) (-)
- B/23d Engr (OPCON)
- D/23d Engr (OPCON)

3RD BRIGADE

- 1-94 Mech
- 1-11 Armor (-)
- 1-22 Cav
- B/1-12 Armor
- 1-52 FA (DS)
- 3/A/440 ADA (atchd for CFA opn)
- 3/B/23d CEWI
  - (3 GSR Tm, 3 REMS Tm)
- 1 IPW Tm/23d CEWI
- 1 OPSEC Tm/23d CEWI
- C/23 Engr (-) (DS)
- C/510 Engr (-) (OPCON)

DIV ARTY

- 1-53 FA
- 70th FA Bde
- 2-606 FA (8, SP)
- 2-607 FA (8, SP)
- 2-610 FA (8, SP)

DIV TRP

- 1-440 ADA (C/V) (-)
- 23d Avn Bn (+)
- 333d Cml Det (CBRE)
- 23d CEWI (-)
- Tm, 2/C/220 EW Bn
- 23d Engr (-)
  - D/510 Engr (-) (OPCON)
  - 5080 Engr Cbt Spt Equip Co (OPCON)
- A (AH) 120 Bn (Sep) (OPCON)
- 23d MP Co
- 23d Sig

DISCOM

- 23d AG Co
- 23d Fin Co
- 23d Maint
- 23d Med
- 23d S&T

TABLE 2

ENEMY ORDER OF BATTLE

SOUTHERN FRONT

Code Name -- MOCHALKA
Code Number -- PBC024

UNIT	COMMANDER	CODE NO.
CG	A/GEN KOMAROV, A.	
CofS	C/GEN BALMASHEV, R.	
4 CAA	A/GEN BARATYNSKY, P.	DMT289
12 CAA	A/GEN ANOKHIN, B.	
24 CAA		MSY789
8 GTA		WXM735
17 TAC Air Army	A/A/GEN BORETSKY, P.	
4 Abn Rfl Div		TAN817
16 Arty Div		GF0320
67 SCUD SSM Bde	MG OSADCHIY, Ya.	
19 SCALEBOARD SSM Bde	MG PERSHAY, F.	
4 SAM Bde (GANEF)		CTK212
U/Engr Bde	COL VASIL'KOV, I.	
20 Cml Bde		QTZ388
U/I Intcp Regt		XYF872
20 MT Bde		HND094
17 Sig Bde	COL MERKUSHOV, R.	GLH919
C of R	MG KORNEV, L.	EOU262

Unit History. Organized in 1958 and assigned to Army Group Muskovy. In July 1960, in coordination with the Northern Front, launched a major offensive and succeeded in regaining the ground lost by the army. In January 1961, the 8th Gd Tk Army and the 12th CAA were assigned to the front, and it was designated to man the southcentral European sector.

OFFENSIVE OPERATIONS: EUROPEAN SETTING

OFFENSIVE OPERATIONS

EUROPEAN SETTING

STRATEGIC ENVIRONMENT

Following World War II, Germany was split; the United States, Great Britain, and France had captured the western portion, and the Hanslande Republic the eastern segment. The western allies formed the North Atlantic Treaty Organization (NATO) with the stated purpose of maintaining peace through security and defense preparedness. The Hanslande Republic and its allies interpreted the presence of NATO as a threat to their existence; therefore, they entered into a mutual defense unification entitled the Popular Eastern Alliance (PEA). The primary proponents for this pact were the Hanslande Republic (HR), Democratic Feldlande (DF), the Republic of Ostlande (OS), and the Hinterlande Republic (HT).

The reality of deployed NATO and PEA forces in Northern and Central Europe inexorably poses the threat of tension and crisis escalating to war. Combined with military forces of other alliance members, the European theater is composed of large, modern, and potentially destructive forces, unparalleled in the history of warfare.

Northern and Central Europe	NATO	Popular Eastern Alliance
Combat and Direct Support Troops Available	630,000	895,000
Tanks	7,000	19,500
Tactical Aircraft	2,350	4,075
Nuclear Weapons	7,000	3,500

CHRONOLOGY OF EVENTS LEADING TO HOSTILITIES

(1) On 8 August PEA nations initiated full mobilization. Member nations made every effort to limit NATO intelligence operations and thus hoped to complete substantial military preparations without permitting a firm indication of their intent.

(2) On 9 August, a forthcoming field exercise to test PEA defense plans was publicly announced. A restriction on foreign travel within PEA countries was invoked.

(3) On 10 August, intelligence reports indicated that Hanslande Republic military traffic heading west into Democratic Feldlande was unusually heavy and appeared excessive to the needs of the previously announced field exercise. Supreme Allied Commander Europe (SACEUR) ordered a state of Military Vigilance.

(4) By 11 August, the PEA buildup in Eastern Europe was apparent to the West. Increased rail, highway, and air activities, as well as the arrival of several Hanslande Republic divisions in Democratic Feldlande, had been confirmed. Authority to declare Simple Alert, was requested by SACEUR.

    (a) The request was transmitted to the NATO Secretary General, who chaired the Defense Planning Committee (DPC). The permanent representatives to the DPC were polled by the Secretary General. After consulting with their national governments, as well as their permanent representatives to the NATO Military Committee, no objections to SACEUR's request were voiced and the declaration of Simple Alert was authorized.

(b) As a result, SACEUR alerted allied force headquarters in northern, central and southern Europe. Headquarters, Allied Forces Central Europe (AFCENT), in turn, placed its two Army groups and Headquarters, Allied Air Forces Central Europe (AAFCE), along with its two Allied Tactical Air Forces (ATAF's) on increased alert.

(5) On 13 August, because of the increased pace of the PEA buildup, SACEUR issued planning guidance and requested authority to declare Reinforced Alert. The DPC approved the request. Efforts by the United Nations (UN) to halt the PEA buildup were unsuccessful. Commander in Chief Allied Forces Central Europe (CINCENT) issued his theater guidance.

(6) On 14 August, evidence was received that PEA forces were mobilizing and would soon attack. As a result, SACEUR received authorization from the DPC to declare General Alert. NATO forces began moving to their assigned emergency defense positions. Obstacle construction was initiated. The US Congress declared a state of national emergency and ordered units and members of the Ready Reserve and Standby Reserve to active duty (Section 672, Title 10, US Code). The President ordered the deployment of dual-based forces to Europe. Other NATO nations commenced mobilization at the same time.

(7) By 18 August, a major portion of the Hanslande Republic theater reserve forces had arrived in the western section of the Republic of Ostlande where they were deployed along lines of communication that would facilitate their rapid western movement into Democratic Feldlande.

(8) On 20 August, PEA units were detected moving towards the western borders of Democratic Feldlande and Hinterlande Republic. NATO units patrolling border areas reported the evacuation of civilians and other noncombatants.

(9) At 210400 August 1981, armed forces of the Popular Eastern Alliance (PEA) launched a nonnuclear attack against North Atlantic Treaty Organization (NATO) forces in the Federal Republic of Germany.

(10) Central Army Group (CENTAG) conducted a successful active defense, severely punishing the leading divisions and preventing commitment of the divisions of the opposing armies' second echelons. Forces in Northern Army Group (NORTHAG) were not as successful, however, and CENTAG was ordered to delay back to positions east of the Rhine commencing on 26 August. The entry of French forces into the conflict at this time, combined with increasingly effective air interdiction of bridges and highways, immobilized the front's second echelon tank army east of the international boundary and south of the 10th (US) Corps sector.

(11) The PEA developed two salients in NORTHAG (see Figure 1). One, south of Hamburg, threatened Bremen and another, just north of the CENTAG boundary, threatened Muenster. To reinforce these more successful attacks, the PEA commander stripped three second-echelon divisions from the armies opposing the 10th (US) Corps for commitment against Muenster and ordered the Northern Front's second-echelon army committed against Bremen.

(12) On 28 August, Supreme Allied Commander, Europe (SACEUR), ordered CENTAG to terminate the delay and occupy defensive positions in the vicinity of the current line of combat. A separate armored brigade and an air assault brigade were detached from 10th (US) Corps and attached to NORTHAG. All remaining units were alerted for imminent counteroffensive operations to relieve pressure on NORTHAG.

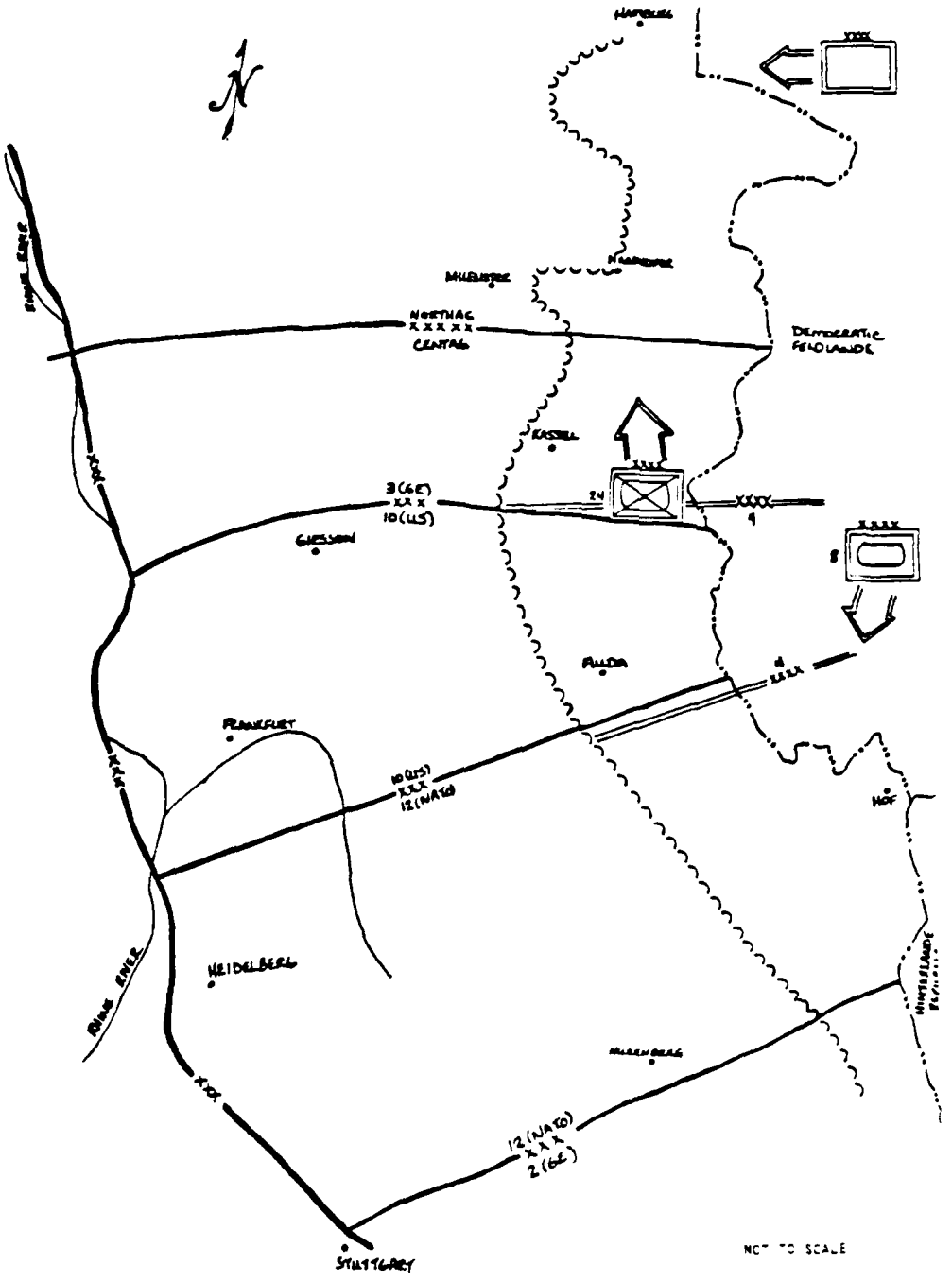

FIGURE 1. SKETCH MAP OF CENTAG DISPOSITIONS

(13) The early declaration of a state of national emergency by the US Congress on 14 August greatly facilitated the reinforcement of Europe. The President immediately ordered the deployment of the dual-based 53d and 54th Mech Div and the 25th Armd Div and called the Ready Reserve and Standby Reserve to active duty. By 25 August, the 54th Mech Div was available for commitment in the defense. The other two heavy divisions, a number of field artillery brigades, and other combat support and combat service support units were closing rapidly. By early September, conditions would favor CENTAG's counter-offensive.

(14) The mission of the 10th (US) Corps is to attack D-day, H-hour, to disrupt enemy defenses and secure the general line Neuhof-Grossenlueder-Eulersdorf-Neukircher-Treysar. On order, continue attack to the east to restore the international boundary.

52 d Mechanized Division

Mission: On order, attack to disrupt enemy defenses and secure the general line Eulersdorf (NB3221)-Neukirchen (NB2437)-Treysa (NB1441). On order, continue the attack to the east to restore the international boundary.

Comparison of Forces:

Friendly Force:

The 52d Mechanized Division will be operating as part of the 10th Corps as depicted in Figure 2. The 52d Mechanized Division will pass through 23d Armored Division and make the Corps main effort, 23d Armored Division assists passage and then becomes Corps reserve. The 52d Mechanized Division is at full strength, their troop list is given in Table I. All equipment has been issued, no major equipment shortage exists. Troops have been undergoing intensive combat training, morale is good.

Opposing Force:

The forces opposing the 52d Mechanized Division are elements of the 4th Combined Arms Army (CAA). All regiments and divisions are assumed to have a normal allocation of organic combat support and combat service support units (MRL, engineer, signal, etc.). The organic artillery unit of a motorized rifle regiment of the 4th CAA is confirmed to be a battalion of 122-mm self-propelled howitzers. Divisional 152-mm howitzer battalions are also self-propelled. Table II contains the opposing force order of battle.

Enemy forces have suffered severe losses in all lead divisions (up to five maneuver battalions have been eliminated per division).

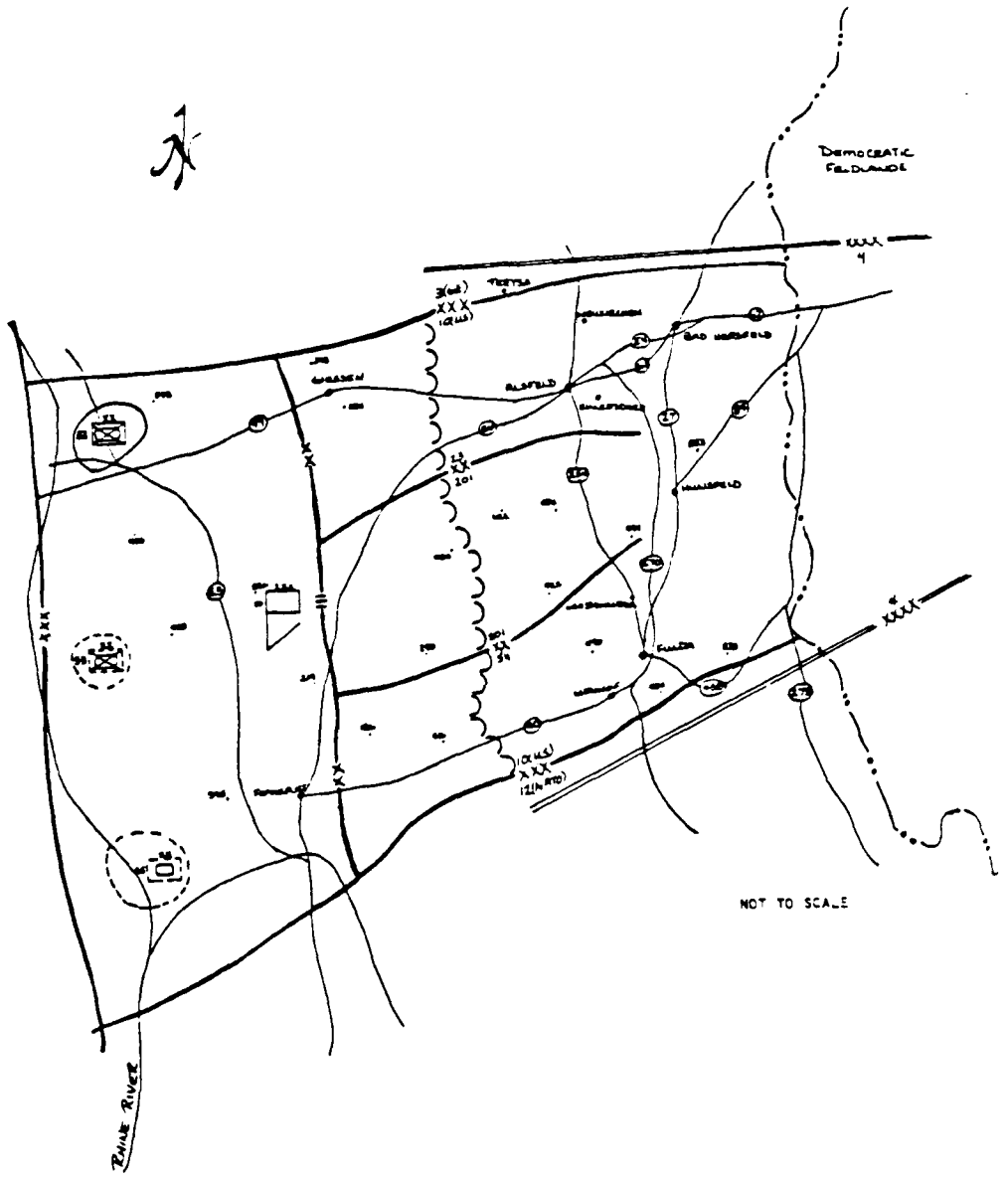

FIGURE 2. CORPS AREA OF OPERATION

TABLE I

52d MECHANIZED DIVISION TROOP LIST

1-77 Mech
1-78 Mech
1-79 Mech
1-80 Mech
1-81 Mech
1-82 Mech
1-2 Armor
1-3 Armor
1-4 Armor
1-5 Armor
1-25 Armor
1-23 Cav

52d Tgt Acq Btry
1-40 FA (155, SP)
1-41 FA (155, SP)
1-42 FA (155, SP)
1-43 FA (8, SP)
1-441 ADA
52d Avn
- A/52d Avn (Div Avn)
- B/52d Avn (Cbt Spt Avn)
- C-D/52d Avn (Atk Hel)

52d CEWI
52d Engr
52d MP Co
52d NBC Def Co
52d Sig
52d Mech DISCOM

69th FA Bde (Attached)
- 2d Bn (8, SP) 608th FA
- 2d Bn (8, SP) 609th FA
- 2d Bn (155, SP) 638th FA
- 2d Bn (255, SP) 639th FA
- 2d Bn (155, SP) 640th FA

2d Bn (Imprv-Hawk), 462d ADA (DS)

501st Engr Cbt Bn (Corps) (OPCON)

TABLE II

OPPOSING FORCE ORDER OF BATTLE

4th Combined Arms Army (CAA) (Reorganized)

31 GMRD[1]
- 59 GMRR
- 84 GMRR
- 120 GMRR
- 87 GMTR
- 31 Indep Tk Bn
- 1 Arty Regt
  - 60 122-mm How Bn
  - 21 152-mm How Bn
  - 11 FROG Bn

32 MRD
- 39 MRR
- 44 MRR
- 52 MRR
- 181 MTR
- 32 Indep Tk Bn
- 93 Arty Regt
  - 181 122-mm How Bn
  - 37 122-mm How Bn
  - 40 152-mm How Bn
  - 14 FROG Bn

49 MRD[1]
- 168 MRR
- 172 MRR
- 177 MRR
- 160 MTR
- 49 Indep Tk Bn
- 33 Arty Regt
  - 172 122-mm How Bn
  - 50 152-mm How Bn
- 86 FROG Bn

36 GMRD
- 33 GMRR
- 41 GMRR
- 132 GMRR
- 85 GMTR
- 36 Indep Tk Bn
- 10G Arty Regt
  - 88 122-mm How Bn
  - 44 152-mm How Bn
  - 22 FROG Bn

38 GMTD
- 182 GMTR
- 186 GMTR
- 190 GMTR
- 165 GMRR
- 34G Arty Regt
  - 3 122-mm How Bn
  - 71 122-mm How Bn
  - 83 FROG Bn

16 Arty Div (-) (Front)
- 29 130-mm Gun Regt
- 14 152-mm Gun-How Regt

48G Arty Regt (CAA)
- 50 130-mm Gun Bn
- 35 130-mm Gun Bn
- 10 152-mm Gun-How Bn

79 Arty Regt (CAA)
- 16 130mm Gun Bn
- 42 130mm Gun Bn
- 30 152mm Gun How Bn

46 MRD (remnants)
- 1 MRB, 144 MRR
- 3 MRB, 150 MRR
- 1 MTB, 131 MTR
- 2 MTB, 131 MTR
- 8 152-mm How Bn

OFFENSIVE OPERATIONS: MIDDLE EAST SETTING

OFFENSIVE OPERATIONS:

MIDDLE EAST SETTING

STRATEGIC ENVIRONMENT

The strategic significance of the Middle East stems from its key location at the junction of three continents, from its vast oil resources, and from centrality to three major religions. As a result the Middle East has been the scene of almost continuous conflict for centuries. Over the intervening years since the end of World War II the United States has become more involved in the Middle East especially since Britain and France have withdrawn their influence from the area. Close relationship developed between the republic of Dromar and the United States, resulting in the signing of a bilateral defense agreement between the two countries in 1967. The agreement was in response to extensive Pakland military equipment deliveries to Saida, a hostile and radical nation bordering Dromar. Between 1967 and 1973 the situation in the Middle East remained just short of erupting. In 1973, intelligence sources indicated that Pakland was delivering increasing numbers of offensive weapons to Saida. By 1974 the Saidan forces posed a significant threat to Dromar. The pro Western stance of Dromar during the oil embargo of 1974 brought severe criticism from the other Middle Eastern petroleum exporters.

By July 1975, there was a significant amount of evidence of activities prejudicial to the interests of the United States. In response, the National Command Authority (NCA) directed the Joint Chiefs of Staff (JCS) to review treaty obligations with Dromar. While doing this the JCS determined that plans should be prepared for possible employment of US military forces in support of Dromar should an eventuality arise.

CHRONOLOGY OF EVENTS LEADING TO HOSTILITIES

(1) February 1981. The Saidan Premier renewed historic claims to lands awarded to Dromar by the former Colonial powers in the late 19th century. Under the banner of Area Unity, Saida asserted that all boundaries established under Colonial regimes invalid and demanded their elimination. Dromar replied in a news release that any violation of her national sovereignty would meet with grave consequences.

(2) March - April 1981. Saida published an area map redefining the southern border with portions of Dromar indicated under Saidan control. The map was widely distributed along with inflammatory messages proclaiming Dromar as a regional traitor in the camp of Western imperialism.

(3) May 1981. Dromar informed the Chief, US Military Assistance Advisory Group, of intentions to activate a third division. The Defense Ministry submitted an emergency request for additional Military Assistance Program equipment and training. The request was forwarded to CINCEUR, along with a recommendation for approval.

(4) 8 June 1981. Saida mobilized the two reserve divisions and activated the Combined Arms Army and the Tank Army. The Dromar Ministry of Defense directed that training of the 3rd Division be accelerated and requested immediate consultation with the US under terms of the 1967 Mutual Defense Treaty.

(5) 20 June 1981. Saidan Armed Forces commenced massive maneuvers along Dromar-Saida border.

(6) 23 - 25 June 1981. Maneuvering Saidan forces reportedly violated Dromarian territory on numerous occasions. On 24 June elements of the Dromarian Border Legion engaged a Saidan armored reconnaissance unit one mile south of the border. Both sides suffered casualties before the Saidans were forced to withdraw. On 25 June, an F-5 of the Dromarian Air Force received ground fire while patrolling south of the border area. A flight of F-4 aircraft was scrambled but unable to detect the firing site.

(7) 25 June 1981. Dromarian Forces ordered to forward defensive positions.

(8) 26 - 27 June 1981. Repeated border skirmishes and exchanges of artillery fire occurred.

(9) 28 June 1981. Saidan forces crossed the Saidan-Dromar border on 280415 June with three divisions: 4th Motorized Rifle, 6th Motorized Rifle and 7th Tank Division from west to east. The attack was supported by an estimated forty (40) battalions of artillery and 200 close air sorties. At the same time, approximately 400 enemy air sorties attacked Dromarian aircraft, divisional air defense control centers, radar sites, airfields and command and control installations. Heavy fighting developed at each point of the Saidan attack. Dromar defenses remained essentially intact through the morning and early afternoon of 28 June. Late in the afternoon of 28 June, Saida committed second echelon elements.

(10) 1 - 5 July. Under heavy pressure by the Saidan forces, Dromarian prepared positions gradually eroded.

(11) 6 - 31 July. Elements of the 20th (US) Corps and the 10th (US) AF were deployed to Dromar by air and sea. On closing in Dromar, US forces conducted defensive operations to halt enemy forward movement.

By late July, the enemy advance had been successfully halted. Presently, the 20th (US) Corps has been given the mission to restore the Dromarian national boundary in zone. Currently the enemy has broken contact and is assumed to be stabilizing new defensive positions. Remnants of several Saidan battalions continue to harass 20th (US) Corps rear area; however, these battalions are not considered a major threat to the US advance.

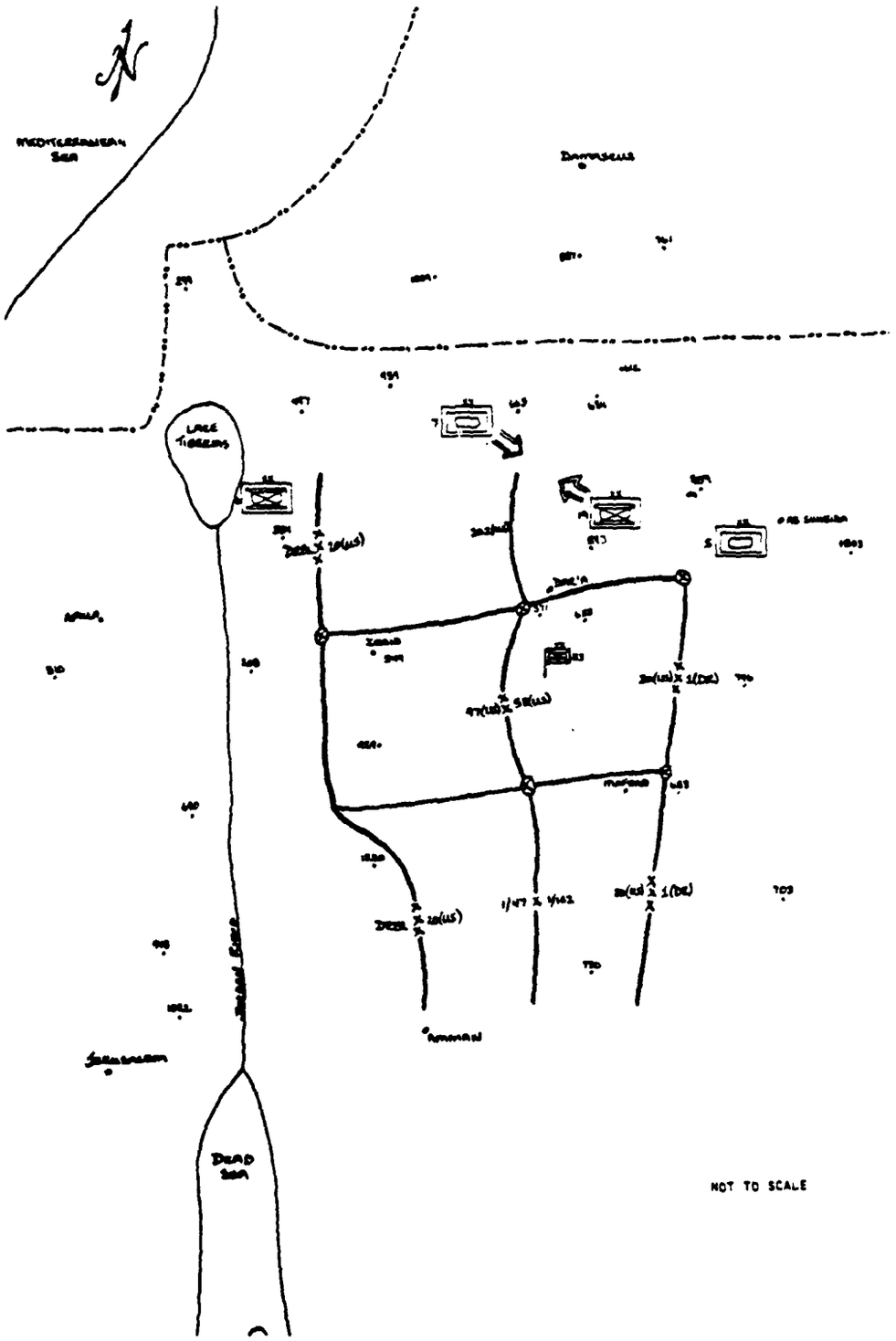

FIGURE 1. SKETCH MAP OF AREA OF OPERATION

Comparison of Forces

(1) Regional Forces

	Dromar	Saida
Ground combat and direct support troops	65,000	100,000
Tanks and armored personnel carriers	1,500	3,200
Air Force personnel	20,000	25,000
Tactical aircraft	221	450

Dromarian ground forces are organized into two mechanized divisions (2d and 3d DR), one infantry division (1st DR), one regiment-sized border legion (DRBL), and one mountain infantry brigade (Sep). These forces are equipped with Western nations equipment. The Dromarian National Air Force contains both F-4 and F-5 aircraft.

Saidan ground forces are organized into six divisions: three tank divisions and three motorized rifle divisions. The principal air defense weapon system of the Saidan force is the SA-6 surface-to-air missile. The tactical aircraft of the Saidan Air Force include the Mig-21 and SU-7.

(2) 53d (US) Mechanized Division

The 53d (US) Mechanized Division will be operating as part of the 20th (US) Corps in the assigned sector as depicted in Figure 1. The Division task organization is given in Table 1. The troops are full strength, no major equipment shortages exist. Also, the troops have undergone intensive training and their morale is good.

Mission:

On order, the 53d Mechanized Division will attack to restore the Dromarian national boundary in zone, vicinity BS4762 to BS5861.

TABLE 1

TASK ORGANIZATION

53d MECHANIZED DIVISION

1st Bde

TF 2-77
2-77 Mech (-)
C/2-2 Armor

TF 2-2
2-2 Armor (-)
C/2-77 Mech

TF 2-3
2-3 Armor (-)
A/2-78 Mech
B/2-78 Mech

A/2-23 Cav (OPCON)
2-40 FA (DS)
A (Comp)/2-441 ADA (C/V) (DS)
A/53d Engr (DS)

2d Bde

TF 2-79
2-79 Mech (-)
C/2-4 Armor

TF 2-4
2-4 Armor (-)
C/2-79 Mech

TF 2-5
2-5 Armor (-)
A/2-80 Mech
B/2-80 Mech

2-41 FA (DS)
B (Comp)/2-441 ADA (C/V) (DS)
B/53d Engr (DS)

3d Bde

TF 2-78
2-78 Mech (-)
C/2-3 Armor

TF 2-80
2-80 Mech (-)
C/2-5 Armor

53d Avn Bn (+)

335th Cml Det (CBRE)

53d CEWI

2-23 Cav (-)

53d Tgt Acq Bty

DEFENSIVE OPERATIONS: MIDDLE EAST SETTING

DEFENSIVE OPERATIONS

MIDDLE EAST SETTING

STRATEGIC ENVIRONMENT

The strategic significance of the Middle East stems from its key location at the junction of three continents, from its vast oil resources, and from centrality to three major religions. As a result the Middle East has been the scene of almost continuous conflict for centuries. Over the intervening years since the end of World War II, the United States has become more involved in the Middle East especially since Britain and France have withdrawn their influence from the area. Close relationship developed between the republic of Dromar and the United States, resulting in the signing of a bilateral defense agreement between the two countries in 1967. The agreement was in response to extensive Pakland military equipment deliveries to Saida, a hostile and radical nation bordering Dromar. Between 1967 and 1973 the situation in the Middle East remained just short of erupting. In 1973, intelligence sources indicated that Pakland was delivering increasing numbers of offensive weapons to Saida. By 1974 the Saidan forces posed a significant threat to Dromar. The pro Western stance of Dromar during the oil embargo of 1974 brought severe criticism from the other Middle Eastern petroleum exporters.

By July 1975, there was a significant amount of evidence of activities prejudicial to the interests of the United States. In response, the National Command Authority (NCA) directed the Joint Chiefs of Staff (JCS) to review treaty obligations with Dromar. While doing this the JCS determined that plans should be prepared for possible employment of US military forces in support of Dromar should an eventuality arise.

CHRONOLOGY OF EVENTS LEADING TO HOSTILITIES

(1) February 1981. The Saidan Premier renewed historic claims to lands awarded to Dromar by the former Colonial powers in the late 19th century. Under the banner of Area Unity, Saida asserted that all boundaries established under Colonial regimes invalid and demanded their elimination. Dromar replied in a news release that any violation of her national sovereignty would meet with grave consequences.

(2) March - April 1981. Saida published an area map redefining the southern border with portions of Dromar indicated under Saidan control. This map redefined the Saidan border as passing through the Jordan Valley and west to include Jerusalem and the Dead Sea. The map was widely distributed along with inflammatory messages proclaiming Dromar as a regional traitor in the camp of Western imperialism.

(3) May 1981. Dromar informed the Chief, US Military Assistance Advisory Group, of intentions to activate a third division. The Defense Ministry submitted an emergency request for additional Military Assistance Program equipment and training. The request was forwarded to CINCEUR, along with a recommendation for approval.

(4) 8 June 1981. Saida mobilized the two reserve divisions and activated the Combined Arms Army and the Tank Army. The Dromar Ministry of Defense directed that training of the 3rd Division be accelerated and requested immediate consultation with the US under terms of the 1967 Mutual Defense Treaty.

(5) 20 June 1981. Saidan Armed Forces commenced massive maneuvers along Droma-Saida border.

(6) 23 - 25 June 1981. Maneuvering Saidan forces reportedly violated Dromarian territory on numerous occasions. On 24 June, elements of the Dromarian Border Legion engaged a Saidan armored reconnaissance unit one mile south of the border. Both sides suffered casualties before the Saidans were forced to withdraw. On 25 June, an F-5 of the Dromarian Air Force received ground fire while patrolling south of the border area. A flight of F-4 aircraft was scrambled but unable to detect the firing site.

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(10) 1 - 5 July. Under heavy pressure by the Saidan forces, Dromarian prepared positions gradually eroded. The likely objective of the Saidan forces is to seize those Dromarian lands portrayed in their map published in March 1981 and redefine the Saida-Dromar border.

(11) 6 - 15 July. Elements of the 20th (US) Corps and the 10th (US) AF are deployed to Dromar by air and sea. The mission of the 20th (US) Corps is to occupy defensive positions and delay enemy forward movement. The Dromarian forces will continue defensive operations to the north of 20th (US) Corps.

Comparison of Forces

(1) Regional Forces

	Dromar	Saida
Ground Combat and direct support troops	65,000	100,000
Tanks and armored personnel carriers	1,500	3,200
Air Force personnel	20,000	25,000
Tactical aircraft	221	450

Dromarian ground forces are organized into two mechanized divisions (2d and 3d DR), one infantry division (1st DR), one regiment-sized border legion (DRBL), and one mountain infantry brigade (Sep). These forces are equipped with Western nations equipment. The Dromarian National Air Force contains both F-4 and F-5 aircraft.

Saidan ground forces are organized into six divisions: three tank divisions and three motorized rifle divisions. The principal air defense weapon system of the Saidan force is the SA-6 surface-to-air missile. The tactical aircraft of the Saidan Air Force are the Mig-21 and SU-7.

(2) 20th Infantry Division

The 20th Infantry Division will be operating as part of the 20th Corps in the assigned sector as depicted in Figure 1. The Division task organization is given in Table 1. No major equipment shortage exists and morale is good.

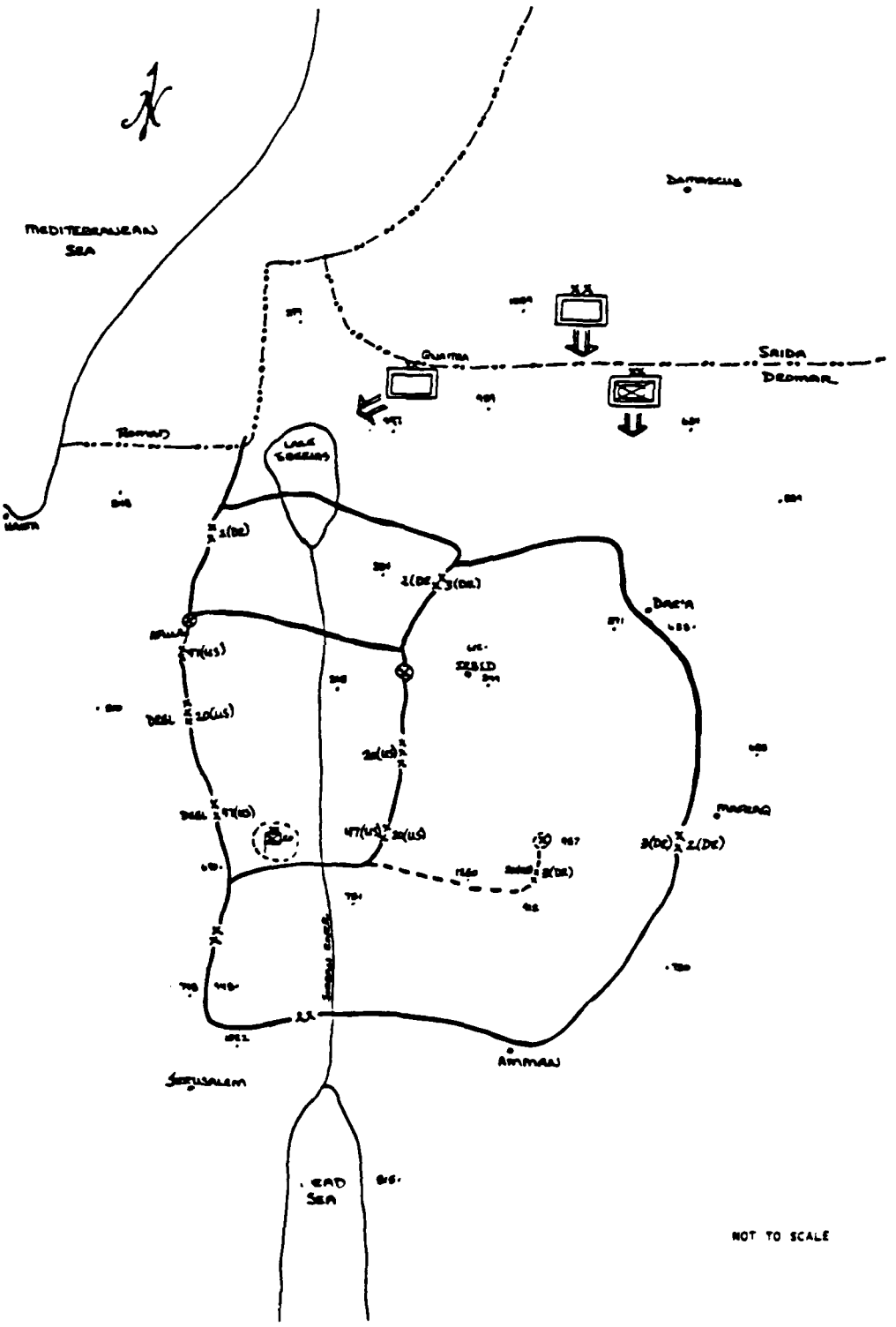


FIGURE 1. SKETCH MAP OF AREA OF OPERATION

Mission:

On closing in Dromar, relieve in place elements of 3d (DR) Mechanized Division in sector; defend in sector from YA511877 to YA785870.

TABLE 1

20th INFANTRY DIVISION

1st BDE

- 1-66 Inf
- 1-67 Inf
- A/1-21 Cav
- 1-45 FA (DS)
- A/20th Engr (DS)

2nd BDE

- 1-68 Inf
- 1-69 Inf
- 1-70 Inf
- 1-1 Armor
- 1-46 FA (DS)
- B/20th Engr (DS)

3rd BDE

- 1-71 Inf
- 1-76 Mech
- 1-83 Mech
- 1-9 Armor

Div Arty

- 1-47 FA
- 1-48 FA
- 2-636 FA (155, SP)
- 2-637 FA (155, SP)
- 2-160 FA (8, SP)
- B/102 FA (Tgt Acq)

Div Trp

- 1-21 Cav (-)
- 1-439 ADA (C/V)
- 20th Avn Bn
- 335th Cml Det (CBRE)
- 358th Cml Det (CBR Agt Sampling & Anal)
- 454th Cml Det (Decon)
- 20th Engr Bn (Cbt) (DS)
- 235th CBTI Co (Div)
- 287th ASA Div Spt Co
- B/211th CA Bn (Tac Spt)
- A/20th CEWI Bn

APPENDIX B

SEMANTIC FEATURES:
DEFINITIONS/SYNONYMS/RELATED TERMS

SEMANTIC FEATURE	DEFINITIONS/SYNONYMS/RELATED TERMS
Activity	General category indicating action; engagement.
Air	Air space of the battlefield.
Air Force/Marines/Navy	Service branches other than Army.
Amount/Quantity	Number of something; "how many."
Artillery	Cannon or missle launchers.
Assets	Resources.
Attack/Counterattack/Penetration	A combat action characterized by fire and maneuver, culminating in a violent assault. Penetration is a form of offensive maneuver that seeks to breakthrough the enemy's defenseive operations, widen the gap created and destroy the continuity of his positions.
Availability	Readiness based on current activity and under communications control (in contact).
Behind FEBA	General category indicating that area of interest which lies behind the FEBA, this includes the participants area of responsibility as well as the area on the flanks.
Capability	Potential of unit based on TOE, training, tactics, personalities, etc.
Configuration	The arrangement of units; template; pattern.
Corps	The echelon higher than participant echelon.
Control Measures	Boundaries, coordinating points, contact points, etc., which assign responsibilities, coordinate fires and maneuver and generally manage combat operations.
Decontamination	Special purpose area for ridding personnel and/or equipment of contaminants.

SEMANTIC FEATURE	DEFINITIONS/SYNONYMS/RELATED TERMS
Defense	The employment of all means and methods available to prevent, resist or destroy an enemy attack.
Disposition/Location	Location of elements of a force, usually the exact location of each unit headquarters and the deployment of the forces subordinate to it; grid coordinates; "where."
Division	Echelon of survey participants.
Drop/Landing Zones	Specified area wherein airborne troops, equipment and supplies are dropped by parachute or free fall delivery of supplies and equipment or area used for the landing of aircraft.
Enemy	*Opposing force; Soviets.*
Engineer	Combat engineers including bridging, minefield emplacement and clearing, position fortification.
EW/Communication	Includes electronic warfare measures, electronic countermeasures, electronic counter-counter measures as well as the communication nets between units and headquarters.
Flanks	Areas adjacent to the participants area of responsibility.
Forward FEBA	General category indicating that area of interest which lies in front of the FEBA; enemy area; enemy terrain.
Friendly	Own; my; our.
Ground/Field	Ground space of the battlefield.
Indication	A sign or signs which point to possible intentions or likely actions.
Logistics	Supply (all classes), maintenance.
Movement	Relocating of troops, equipment, enemy.

SEMANTIC FEATURE	DEFINITIONS/SYNONYMS/RELATED TERMS
Objectives/Plans	The physical object of the action taken. Method by which objective or operation will be accomplished.
Obstacles	Any natural or artificial obstruction that canalizes, delays, restricts or diverts movement of a force; barriers.
Organization	The definite structure of a military element prescribed by a component authority such as a table of organization.
Own Sector	Participant area of responsibility.
Personnel	Men; casualties.
Positions	Location or area occupied by a military unit; locations of a weapon, unit or individual from which fire is delivered upon a target.
Priority	Preferential rating.
Procedure	OP; chain of command; method or methods.
Projected	Predicted; future.
Range/Distance	*The distance between any* given point and an object or target. The extent or distance limiting the operation or action of something. The distance which can be covered over a hard surface by a ground vehicle with its rated payload, using the fuel in its tank and in cans normally carried as part of the ground vehicle equipment. Distance is noted in kilometers.
Rear Area	The area to the rear of the main battle area in which supply, maintenance support, communication centers, and administrative echelons are located.
Refugees/Civil Affairs	Pertains to the civilian population in the area in which military operation is taking place.
Results/Effectiveness	Estimate of outcome of an action; estimate of "how well" an action is going.
Reinforce	The strengthening of a force by committing additional forces, supporting elements of fires.

SEMANTIC FEATURE	DEFINITIONS/SYNONYMS/RELATED TERMS
Reinforcements/Reserves	The portion of the force withheld from action to be available at the appropriate time.
Routes/Avenues	Terrain conducive to the movement of a specified unit, may include terrain relevant to the movement of aircraft.
Smoke	An artifically induced product which attenuates the passage of visible light or other forms of electromagnetic radiation. Includes identification smoke, obscuration smoke and screening smoke.
Special Weapons	Weapons other than those organic to unit; NBC/CBR (nuclear/radiation, biological and chemical).
Status/Situation	Current state of affairs. In the case of units, status refers to effective strength (TOE strength minus losses plus reinforcements). In other cases, status may refer to the degree of readiness or completion, such as status of obstacle emplacement (answer in time to completion).
Supporting Mission	A specific task wherein the action of a force aids, protects, complements or sustains another force in accomplishing its mission.
Surveillance	A systematic observation of airspace or surface areas by visual, aural, electronic, photographic or other means.
Sustainability	Resilience, redundancy, robustness (more than expected capability for extended operations).
Target/Targets	Personnel, materiel or terrain that is designated and numbered for firing.
Terrain	Geographic area.
Threat	The combined features of capability and intentions.
Time	Estimate in minutes, hours or days; "how soon."

SEMANTIC FEATURE	DEFINITIONS/SYNONYMS/RELATED TERMS
Trafficability	Capability or extent to which the terrain will bear traffic or permit continued movement of a force.
Unit Size	Battalion, Division, Regiment, etc.
Unit Type	Mechanized infantry, tank, armor, etc.
Visibility	The greatest distance toward the horizon that objects can be identified visually.
Vulnerability	Danger status; weakness; problem.
Weapons/Equipment/Platforms	Organic to a specific unit, such as a T-72.
Weather	Atmospheric conditions such as wind speed and direction, temperature and humidity.
Withdrawal/Retrograde/Retirement/Delay	Movement of a command away from the opposing force.
1st Echelon	First wave of an opposing force.
2nd Echelon	Second wave of an opposing force.

APPENDIX C

INFORMATION PERSONALIZED WITH VARIOUS GRAPHIC TECHNIQUES

This appendix contains information which participants in this survey have portrayed with personalized methods. The appendix is organized by technique, beginning with the personalized information portrayed with alphanumeric notation, followed by color coding, symbol shape alteration, combined techniques, charts, and new symbols.

INFORMATION PERSONALIZED WITH ALPHANUMERIC NOTATION

Aircraft Flight

Avenues of Approach

Choke Points

Civilian Casualties

Force Ratio

Landing Zones/Pickup Zones

Routes

Weather Impact on Routes

Enemy Information, Such As:

- Activity
- Antiair Weapons
- Antitank Weapons
- Attrition
- Command and Control Nodes
- Communication Status
- Distance Gaps
- Electronic Order of Battle
- Engineer Capability
- Fire Assets
- Movement (Rate)
- Nuclear Capability and Range
- Reserve Committment
- SIGINT/EW (Activity, Asset Type, and Movement)
- Status of Non-Communication Emitters
- Strength
- Task Organization

Enemy Information (Cont'd)

- Threat
- Type of Radioelectronic Combat Employment
- Unusual Communication Equipment
- Unusual Obstacle Capability or Extensive Activity
- Unusual Type of Communication Traffic

Friendly Information, Such As:

- Airlift Capability
- Artillery Organization
- Attack Helicopter Employment
- CAS Availability
- Controlled Supply Rates
- Equipment/Spare Parts Status
- FASCAM Authority and Employment
- Fuel/Ammunition/Personnel Status
- Lift Assets Available
- Obstacle Preparation Status
- Point When Units Must Be Moved
- Positions (Proposed, Best, and Alternate)
- Rear Area Attack Indication
- Resupply Rate
- Smoke Generating Capability
- Tank Recovery Vehicles Available
- Time/Distance Factors
- Unit Status (General)

INFORMATION PERSONALIZED
WITH COLOR CODING

Avenues of Approach
Civil Populace Status
High Ground
Key Terrain
Routes
Trafficability

Enemy Information, Such As:
- Air Strike Locations
- Artillery Tube Caliber
- Known Locations
- Nuclear Capability
- Threat
- Weighted Attack Location

Friendly Information, Such As:
- Attack Helicopter Status
- Climate/Terrain Impact on Land or Air Resupply
- Communication Status
- Command Posts (Which have been targeted)
- Personnel/Equipment Status
- Strength
- Supply Rates (Available and Required)
- Unit Status (General)
- Units (Which can be quickly relocated)
- Weapon Status
- Weapon Range

INFORMATION PERSONALIZED
WITH SYMBOL SHAPE ALTERATION

Breached Barrier Locations
Choke Points
FEBA/FLOT Location
Regions of High Combat Intensity
Weapon Ranges (Friendly and Enemy)

Enemy Information, Such As:
- Activity
- Air Defense Zones
- Bridging Assets
- Composition
- Force Deployment
- Intentions
- Known Locations
- Movement (Frequency, Rate, and Direction)
- Objectives
- Prepared Positions
- Reinforcement Time
- Threat
- Vulnerability
- Weighted Attack Location
- 2nd Echelon Committment

Friendly Information, Such As:
- Attack Helicopter Locations to Support Movement
- Critical Locations for CAS Employment
- Chemical Targets
- Flank Activity
- Nuclear Targets
- Resupply Points (Locations)
- Strength
- Supplymentary Transportation Assets Availability

INFORMATION PERSONALIZED
WITH COMBINED TECHNIQUES

Avenues of Approach
Force Ratio
High Combat Intensity
Holding Areas for Civilians
Routes
Salient Terrain Features
Trafficability

Enemy Information, Such As:
- Alternate Command Posts
- Attack Locations
- Command Post Movement
- Communication Pattern
- Deployment Status
- ECM Capability
- Formations
- Historical Events
- Logistics Status
- Movement
- Objectives
- Strength
- Supporting Communication
- Task Organization
- Time/Distance Factors
- Unit Identification
- 2nd Echelon (Activity, Location, Committment, Readiness)

Friendly Information, Such As:

- Air Force Availability
- Air Routes
- Air Status
- Artillery Location and Organization
- Ammunition Status
- Bridging Status
- Communication Security
- Destruction Ratio
- Engineer Assets Available
- Fallback Positions
- FARP/ASP Proposed Locations
- Incoming Artillery Types
- Maintenance Facility Availability
- Obstacle Plan Status
- Personnel/Equipment Status
- Personnel Replacement Capability
- POL Status
- Position and Obstacle Status
- Prepared Positions Available
- Reinforcement Requirements
- Reserve Availability
- Resupply Status
- Special Mission Implementation
- Strength
- Support Requirements
- Task Organization

INFORMATION PERSONALIZED WITH CHARTS

Capability to Sustain Operations (Friendly and Enemy)

Force Ratio

Weather Projection

Enemy Information, Such As:

- Activity
- Attrition
- Reinforcing Capability, Time, and Indications
- Strength
- Threat

Friendly Information, Such As:

- Air Cav/Attack Helicopter Status
- Ammunition Status
- CAS Availability/Time
- Combat Mulipliers
- Critical Supply Status
- Cross Supply Capability with Adjacent Units
- Damage Assessment
- Equipment Status
- Intelligence Collection Assets Composition and Status
- Nuclear Request Status
- POL Status
- Repair Capability
- Resupply Capability
- Supply Vulnerability
- Task Organization
- Transportation Availability
- Unit Status (General)
- Weapon Status

INFORMATION PERSONALIZED
WITH NEW SYMBOLS OR OVERLAYS

Avenues of Approach
Bridge Status
Critical Terrain
Prohibitive Areas
Salient Terrain Features
Terrain Features (e.g., Slope, Vegetation)
Trafficability (Effects on Air and Artillery)
Weather (Tactical Impact)

Enemy Information, Such As:
- Amount of Communication Traffic
- Distance of Penetration
- Formations
- Ineffective Units
- Weighted Attack Location

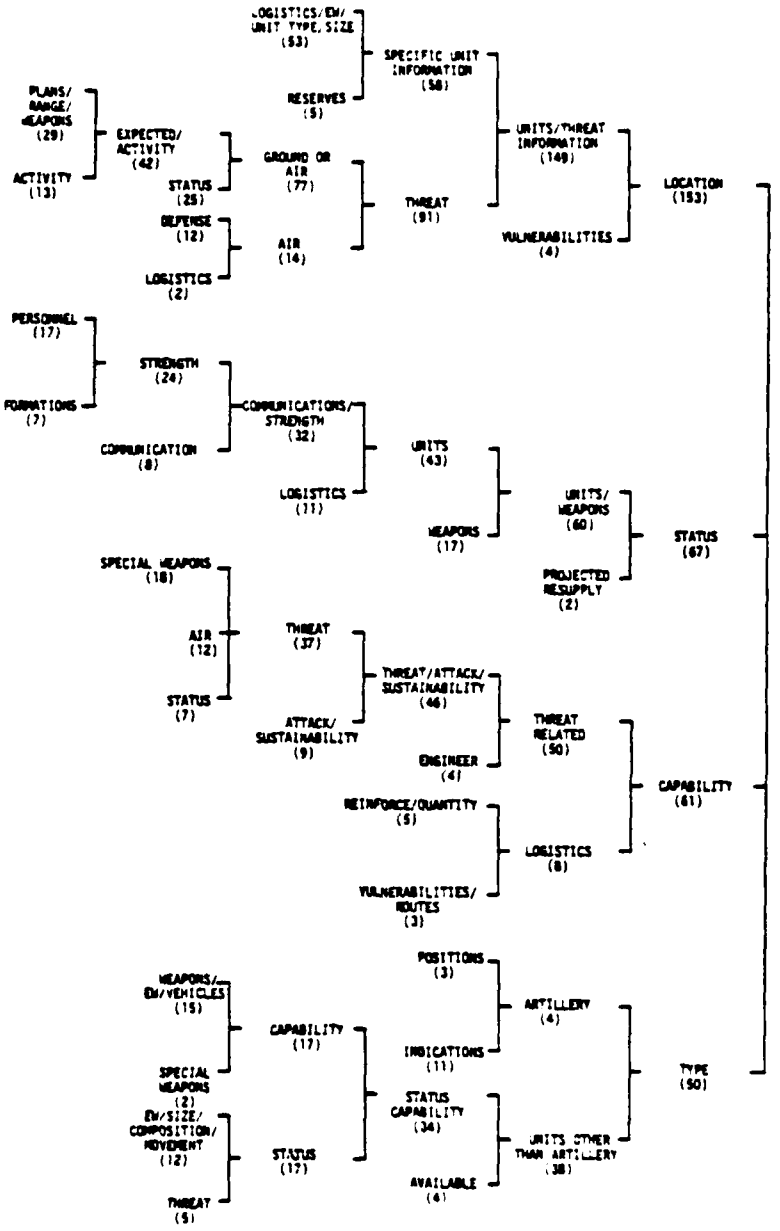
Friendly Information, Such As:
- Activities on Main Avenue of Approach
- Attack Helicopter Locations for Assault
- Indirect Fire Use
- Patrolling and Reconnaissance Plan
- Time/Distance Factors
- Use of Air Mobile Operations (In Enemy Rear)

APPENDIX D

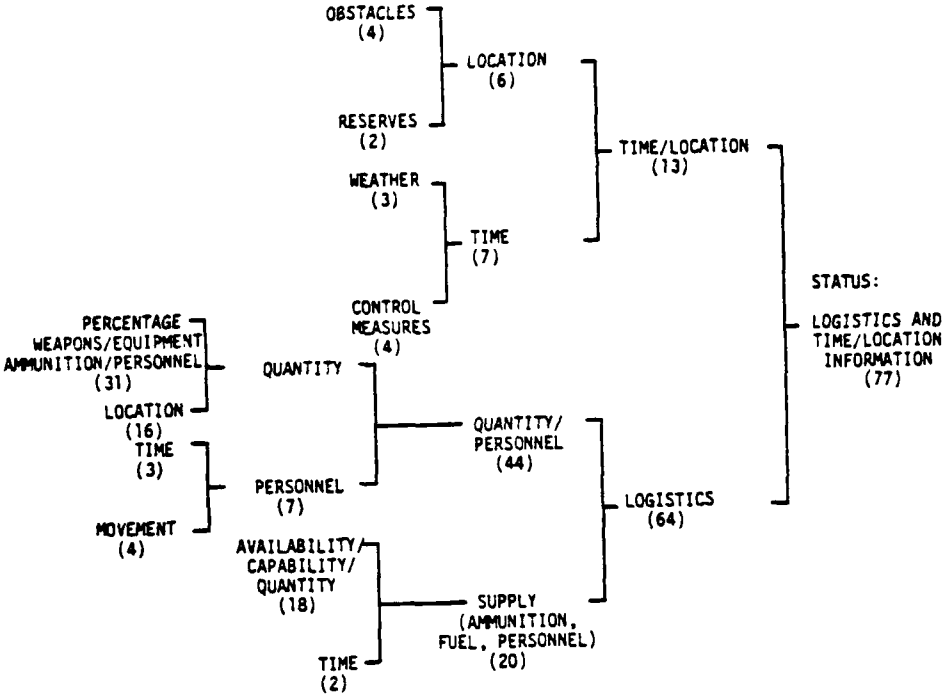
CLUSTER ANALYSES TREE DIAGRAMS

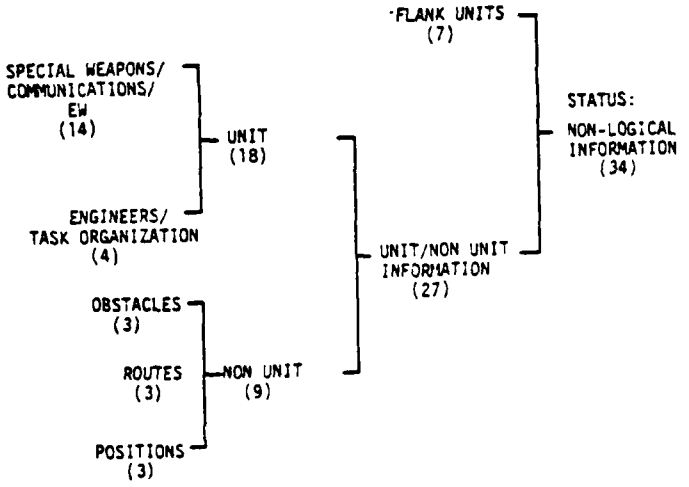
This appendix contains the tree diagrams which resulted from the cluster analyses. The diagrams are organized by analysis and are presented in the order in which they are discussed in the text. The numbers contained in the diagrams reflect the quantity of questions associated with a specific concept. The reader will note that the numbers at any one level in a tree do not in all cases sum to the total in the next higher level. The reason for this is that weak associations, which are discussed in text, are not depicted in the diagrams.

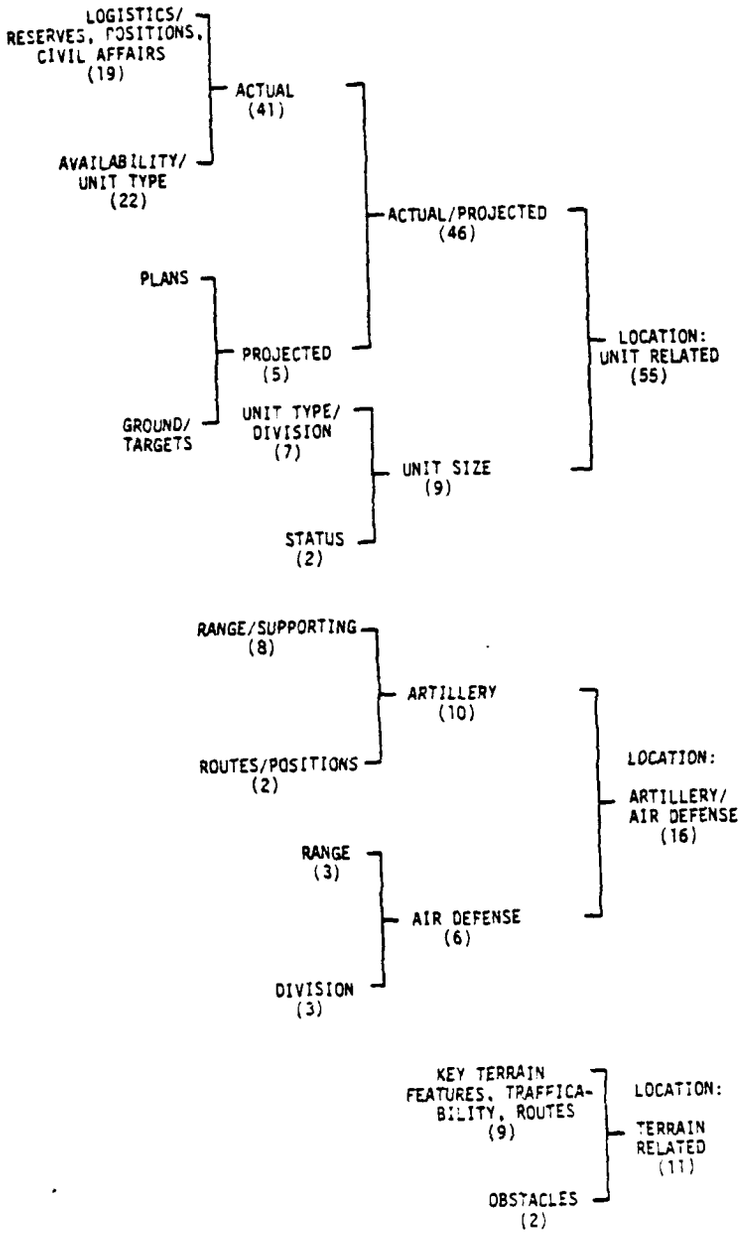
TREE DIAGRAM OF
ENEMY INFORMATION

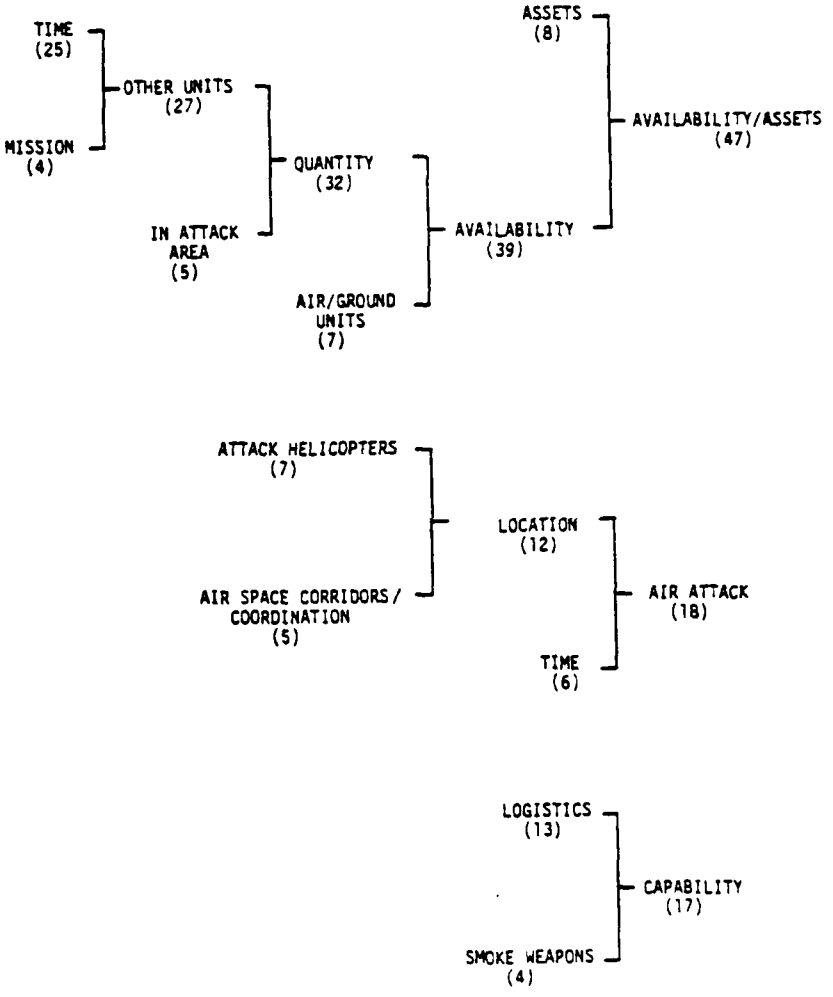


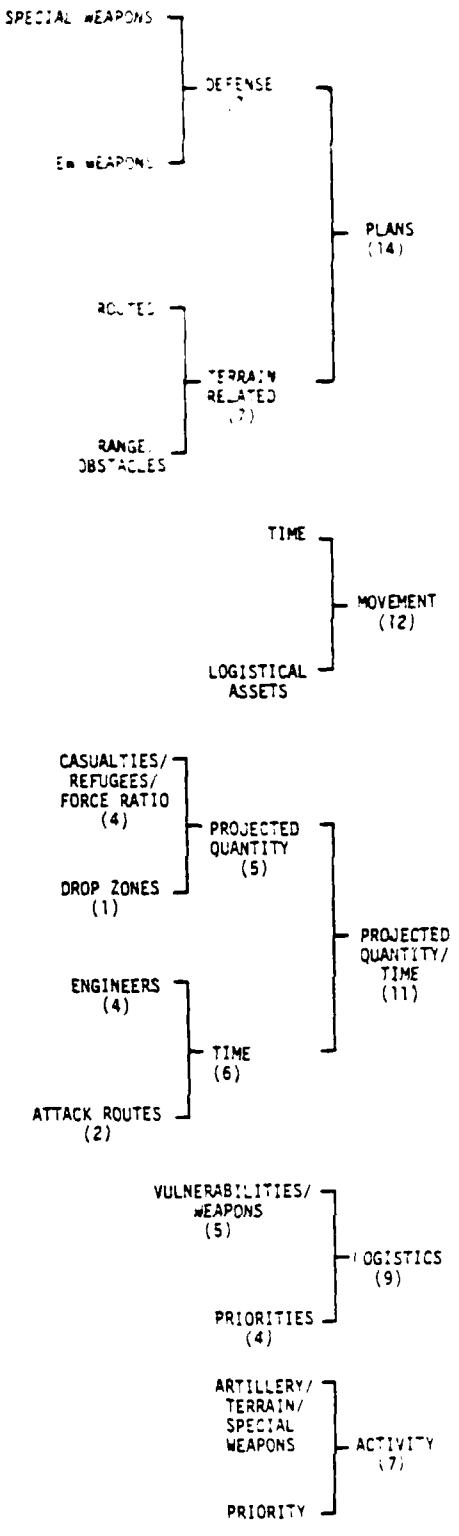
TREE DIAGRAMS OF
FRIENDLY INFORMATION



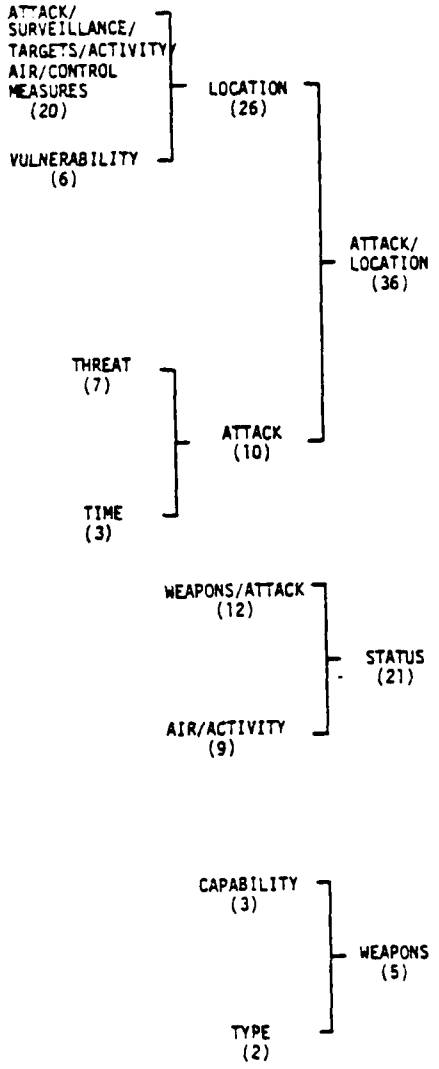



LOGISTICS/ RESERVES, POSITIONS, CIVIL AFFAIRS (19)
AVAILABILITY/ UNIT TYPE (22)
ACTUAL (41)
PLANS
GROUND/ TARGETS
PROJECTED (5)
ACTUAL/PROJECTED (46)
UNIT TYPE/ DIVISION (7)
UNIT SIZE (9)
STATUS (2)
LOCATION: UNIT RELATED (55)
RANGE/SUPPORTING (8)
ROUTES/POSITIONS (2)
ARTILLERY (10)
RANGE (3)
DIVISION (3)
AIR DEFENSE (6)
LOCATION: ARTILLERY/ AIR DEFENSE (16)
KEY TERRAIN FEATURES, TRAFFICA-BILITY, ROUTES (9)
OBSTACLES (2)
LOCATION: TERRAIN RELATED (11)


TIME (25)
OTHER UNITS (27)
MISSION (4)
QUANTITY (32)
IN ATTACK AREA (5)
AIR/GROUND UNITS (7)
AVAILABILITY (39)
ASSETS (8)
AVAILABILITY/ASSETS (47)
ATTACK HELICOPTERS (7)
AIR SPACE CORRIDORS/ COORDINATION (5)
LOCATION (12)
TIME (6)
AIR ATTACK (18)
LOGISTICS (13)
SMOKE WEAPONS (4)
CAPABILITY (17)


SPECIAL WEAPONS
DEFENSE
EW WEAPONS
PLANS
(14)
ROUTES
TERRAIN
RELATED
(7)
RANGE/
OBSTACLES
TIME
MOVEMENT
(12)
LOGISTICAL
ASSETS
CASUALTIES/
REFUGEES/
FORCE RATIO
(4)
PROJECTED
QUANTITY
(5)
DROP ZONES
(1)
PROJECTED
QUANTITY/
TIME
(11)
ENGINEERS
(4)
TIME
(6)
ATTACK ROUTES
(2)
VULNERABILITIES/
WEAPONS
(5)
LOGISTICS
(9)
PRIORITIES
(4)
ARTILLERY/
TERRAIN/
SPECIAL
WEAPONS
ACTIVITY
(7)
PRIORITY

TREE DIAGRAM OF
ENEMY/FRIENDLY INFORMATION



TREE DIAGRAM OF
INFORMATION NOT SPECIFIC
TO ENEMY OR FRIENDLY FORCES